SANITARY SEWERAGE SYSTEM
FOR CRETE, ILLINOIS

BY

M. A. SHERMAN
M. GRODSKY

ARMOUR INSTITUTE OF TECHNOLOGY
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Design of a sanitary
 sewerage system and

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DESIGN OF
A SANITARY SEWERAGE SYSTEM AND DISPOSAL PLANT
FOR THE
VILLAGE OF CRETE, ILLINOIS.

A THESIS

PRESENTED BY

M. A. SHERMAN

M. GRODSKY

TO THE

PRESIDENT AND FACULTY

OF

ARMOUR INSTITUTE OF TECHNOLOGY

FOR THE DEGREE OF

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

HAVING COMPLETED THE PRESCRIBED COURSE OF STUDY IN

CIVIL ENGINEERING

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ACKNOWLEDGMENT.

We hereby take the opportunity of expressing our indebtedness to Professor A. E. Phillips for the many valuable suggestions and information which he gave us during the preparation of this thesis.

We also thank Mr. M. H. McCoy and Mr. H. E. Ashdown, Engineers for the City of Chicago Heights, for such data and information which they have furnished us.

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TABLE OF CONTENTS.

Page.

INTRODUCTION ---------------------------------- 7

PRELIMINARY DATA ----------------------------- 8

DESIGN
- Subdivision into Districts ------------- 9
- Population ------------------------------ 10
- Amount of Sewage ----------------------- 10
- Grades ---------------------------------- 10
- Size of Sewers ------------------------- 10
- Velocity -------------------------------- 11
- Flushing and Ventilation -------------- 19

DESIGN OF PURIFICATION PLANT ------------ 20

CONTRACT AND SPECIFICATIONS ------------- 21
- Notice to Contractors ------------------ 22
- Instructions to Contractors ----------- 23
- Proposal -------------------------------- 24
- Contract -------------------------------- 26
- Specifications for Sewers ------------- 30
- Specifications for Septic Tank --------- 41
- Bond ------------------------------------ 46

ESTIMATE OF COST
- Cost of Sewer -------------------------- 48
- Cost of Septic Tank ------------------- 50

LIST OF MAPS AND DRAWINGS.

PLATE 1. ---------------------- Map of Crete, Ill.
PLATE 11. ---------------------- Map of Crete, Ill., Showing Sewerage System.
PLATE 111. ---------------------- Septic Tank.
PLATE 1V. ---------------------- Sewer Details.
PLATE V. ---------------------- Profiles of Streets (Eight Sheets.)

LIST OF TABLES.

Page.
Table 1. ---------------------------------- 6
Table 11. ---------------------------------- 12
Table 111. ---------------------------------- 18
Velocity Diagram ------------- Opposite page 11

TABLE 1.

CONTENTS OF PROFILES.

STREET	PROFILE SHEET No.
Austin Ave.	3
Benton St.	3
Cass St.	8
Columbia St.	4
Crete Blvd.	7
Division St.	8
East Ave.	5
East St.	2
Elizabeth St.	2
Enterprise Ave.	3
Exchange St.	6
Farm St.	7
Fifth St.	1
First St.	6
Herman St.	7
Hewes Ave.	3
Jefferson St.	6
Linden St.	6
Lincoln Ave.	5
Lumber St.	4
Main St.	1
Mills St.	4
North St.	8
Park St.	2
Perry St.	2
Pipe Line #1.	1
Pipe Line #2.	9
Pipe Line #3.	9
Pipe Line #4.	1
Pipe Line #5.	1
Second St.	8
Selleck St.	2
Third St.	8
Track Crossing	1
Vincennes St.	5
Wood St.	1
Alley W. of Benton St.	4
" W. of Columbia St.	4
" N. of Linden St.	1
" W. of Lumber St.	4
" E. of Main St.	1
" W. of Main St.	1,3,9
" E. of Wood St.	2

INTRODUCTION.

The village of Crete, Illinois is situated on the Chicago & Eastern Illinois R.R., 30 miles from Chicago. It is a residential town, having a population of about a thousand, composed mainly of retired farmers.

Its situation on the Chicago Interurban two miles from Steger and four miles from Chicago Heights, important manufacturing towns lacking residential facilities, gives Crete a favorable opportunity of increasing its population. In order to make living conditions more favorable and to attract the working people from the above mentioned towns, the village board sometime ago installed adequate water and electric lighting systems.. To further improve sanitary conditions the board has decided to put in a sewer system.

The first question that came up for consideration was the choice between a combined and separate sewer system. The streets of Crete with the exception of Main Street are not improved and therefore it is not advisable to put in comprehensive storm sewers. The village at present has some drains and ditches taking care of the storm water. Besides this the combined sewer system would present an enormous outlay of funds to be carried by the present small population. It would not be just to have the present taxpayers carry this extraordinary heavy burden for the needs of the future increased population. It was, therefore, decided to put in a sanitary system alone.

There is a small creek running through the village of Crete. Its velocity is insufficient to carry away the raw sewage as it comes from the mains. It was deemed advisable to put in a disposal plant consisting of a septic tank, in order to purify the sewage before it reaches the creek.

PRELIMINARY DATA.

In collecting data preliminary to the design the first requisite was a map of the village. Mr. M. H. McCoy, city engineer of Chicago Heights, supplied us with a map which he compiled while designing the water system for Crete, Illinois. This map contained a layout of the streets and alleys, land subdivisions and lot lines, and showed the outline of the creek. A copy of this map is enclosed in this thesis as Plate 1.

The streets and important alleys were leveled by Mr. H. E. Ashdown, assistant engineer of Chicago Heights. Upon application to him he consented to let us have a copy of his field notes. From these notes the profile of each street and surveyed alley was drawn on cross section paper.

After drawing a topographic map of the town, and making a preliminary layout of the sewer lines, it was found that the field notes on hand did not contain the levels of all the streets on which sewers were to be laid. A trip to the town was made and those streets were leveled. Having decided from the natural drain of the land upon the location of the septic tank, a stadia survey was made of this proposed location.

DESIGN.

A study of the topographic map will show that the general slope of the ground is from the southwest to the northeast. It is practical to place the outlet as near the creek as possible; in this case the outlet was placed just north of the city limits. The eastern section of the village being practically on the same level as the outlet made it necessary to consider it as a separate sewage district.

The rest of the town is divided into two parts by the C. & E. I. right-of-way. In order not to cross these railroad tracks too often, the western portion was made into a separate sewage district. Besides the above consideration the western district lies further north than the central and it was therefore inadvisable to run its sewage first south to the central district and the north towards the outlet.

The most advantageous route from the drainage standpoint would be along Main Street. This route would exclude any sewer lines from running in alleys, which are rather narrow for construction purposes. However, Main Street is the only street in the town whose surface is improved. It is covered with a waterbound macadam, laid some twenty years ago. The macadam was kept in good condition during that period and presents now a good and compact surface.

The running of a sewer line on Main Street would necessitate the tearing up of the surface. This is objectionable because the street would have to be resurfaced, and due to the fact that this torn-up portion would keep on settling during the next three or four years, which would require constant attention to keep the whole surface on the same level. The expense of tearing up, resurfacing and maintaining the street would amount to about $6000.

In order to avoid this extra paving expense, it was deemed advisable to run two lines parallel to Main Street, one to the east and the other to the west. The estimated cost of the extra line is $1800. The eastern parallel line runs through and drains the central district and combines with the trunk line of the eastern district at junction #1. The western parallel line drains only a portion of the central district and empties into the trunk line of the western district.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Population.

The population was estimated as follows:

Six persons to a lot in the original town.

Four persons to a lot in the outlying districts.

The total population for each district was estimated and is given in table II.

Amount of Sewage.

In order to determine the amount of sewage per capita per day the following items should be taken into consideration.

I. The nature of the existing water system.
II. The amount of seepage from ground water.
III. The character of the town, whether residential or manufacturing.
IV. The size of the town.

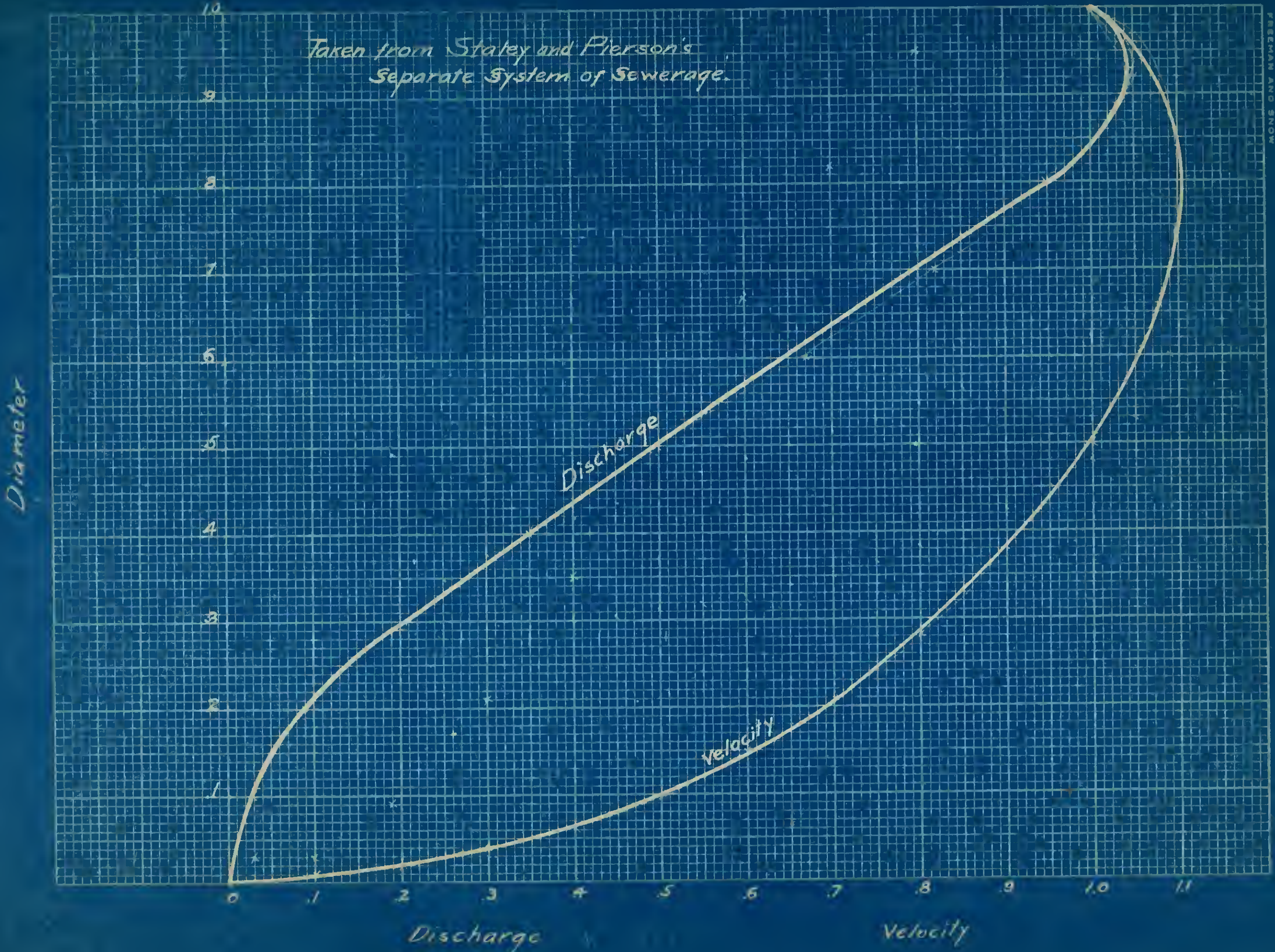
Taking the above items into consideration it was decided that 110 gallons per capita per day would represent a maximum average figure for this town.

Grades.

The elevation of the outlet is 65.6 feet above datum. The elevation of the sewer at the south limits was assumed 94 feet, giving a total fall of 28.4 feet. The direct distance from the south limits to the outfall is 5300 feet giving an average grade of 1:180 Grades steeper than the average were used near the dead ends and flatter grades used near the outfall, designed so as to balance each other. The grades as decided upon are given in table II.

Size of Sewers.

The sizes of pipes were obtained from Staley & Pierson's "The Separate System of Sewerage." Between pages 108 and 109 in this book is inserted a table compiled from Baldwin Latham's Tables, giving size of pipe when grade and discharge are known. The minimum size of pipe used was 8 in.; the table gave 10 in. pipe for sewer lines near the outfall and a 12 in. pipe for the outlet.



Taken from Staley and Pierson's Separate System of Sewerage.

FREEMAN AND SNOW

Velocity.

The velocities were obtained from the accompanying diagram and from Baldwin Latham's Tables #15 and #21.

Baldwin Latham's Table #21 gives the full discharge of a pipe when the size and grade are known. Our computations in table 11 give the actual discharge through such a pipe. Having these two quantities, the percentage of full flow is obtained. With this percentage, the height of flow in the pipe is given by Staley & Pierson's diagram, and with this depth of flow the percentage of full velocity is obtained from the same diagram. Baldwin Latham's Table #15 gives the velocity of a known pipe when flowing full. Knowing the percentage and the full velocity , the actual velocity is easily obtained.

Example of Calculations.

An 8 in. pipe on Cass Street between Wood Street and the alley west of Wood Street is laid at a grade of 1:250 and has an actual discharge of 159,730 gallons per day.

Baldwin Latham's Table #21 gives a full discharge of 575,000 gallons per day. The percentage of full discharge -- 159,730/575,000 = 27.8%.

From diagram of Staley & Pierson the depth of flow for the above percentage is 35%. From the same diagram the percentage full velocity is 87%.

Baldwin Latham's Table #15 gives full velocity for this case 153 feet per minute or 153/60 = 2.55 feet per second

Actual velocity equals 2.55 x .87 = 2.22 feet per second.

TABLE 11 a.

STREET	FROM	TO	POPULATION	GAL. per day	TOTAL SEWAGE	GRADE	SIZE
Exchange	Limits	Lincoln	64	7040		1:200	8"
Jefferson	Peoria	"	128	14080		1:140	"
Lincoln	Alley	Jeff.	32	3520		1:50	"
"	Jeff.	Exchange	24	2640	20240	1:350	"
Exchange	Lincoln	Columbia	28	3080	30360	1:200	"
First	Peoria	Columbia	176	19360		1:160	"
Columbia	First	Exchange	108	11880	31240	"	"
Exchange	Columbia	Vincennes			61600	1:200	"
Farm	Limits	"	141	15510			
Vincennes	Farm	Division	634	69740	85250	1:200	"
Mills	Exchange	Division	96	10560		1:270	"
Division	Mills	Vincennes	60	6600	17160	"	"
Vincennes	Division	Exchange	56	6160	108570	1:200	"
Exchange	Vincennes	Lumber			170170	"	"
Lumber	Exchange	Second	156	17160	187330	1:180	"
Second	Peoria	Columbia	132	14520		1:200	"
Columbia	First	Second	48	5280		1:56	"
"	Third	"	64	7040	26840	1:200	"
Second	Columbia	Lumber				"	"
Lumber	Second	Third	36	3960	218130	1:250	"
Lumber	Fourth	Third	48	5280		1:75	"
Third	Lumber	Pipe Line #1			223410	1:250	"
PipeLine2 W.ofMain	Limits	Herman	660	72600		1:250	"
Herman	Vincennes	Pipe Line #2	56	6160		1:100	"
PipeLine2	Herman	Division	168	18480	97240	1:250	"
Alley W. ofBenton	Cass	Division	48	5280		1:100	"
Division	Alley	Benton			5280	1:100	"
Division	Benton	Alley			102520	1:250	"
Alley W. of Main	Division	Exchange	120	13200	115720	"	"
Exchance	Alley	Benton	15	1650	117370	"	"
Alley W. ofBenton	Cass	Exchange	66	7260		1:65	"
Exchange	Alley	Benton			7260	1:75	""

TABLE 11 a.(Cont'd).

STREET	FROM	TO	POPULATION	GAL. per DAY	TOTAL SEWAGE	GRADE	SIZE
Benton	Exchange	North	102	11220	135850	1:200	8"
North	Main	Benton	27	2970		1:50	"
Benton	North	First	60	6600	145420	1:200	"
First	Main	Benton	12	1320		1:100	"
First	Benton	Pipe Line #1	20	2200	148940	1:200	"
Pipe Line #1	First	Third	20	2200	151140	1:200	"
Pipe Line #1	Third	Alley			374550	1:350	10"
Alley No. of Linden	Pipe Line #1	Alley	40	4400	378950	"	"
Alley W. of Main	Linden	Alley	12	1320		1:100	8"
Alley W. of Main	Alley	Fifth	8	880	381150	1:350	10"
Fifth	Alley	J'Ct.#2			"	"	"
East Ave.	Burville	Crete	162	17820		1:330	8"
Crete	East Ave	Austin	188	20680	38500	"	"
Austin	Burville	Crete	108	11880		1:200	"
Crete	Austin	Hewes	80	8800	59180	1:330	"
Hewes	Burville	Crete	108	11880		1:200	"
Crete	Hewes	Enterp.			71060	1:330	"
Alley E. of Main	Burville	Crete	81	8901		1:220	"
Crete	Alley	Enterp.			8910	"	"
Pipe Line #3	Crete	Herman	336	36960	116930	1:200	"
Herman	East Ave	Pipe Line #3	224	24640		1:80	"
Enterprise	Burville	Crete	108	11880		1:175	"
Pipe Line #3	Herman	Division	192	11120	152690	1:200	"
Division	Elizabeth	Pipe Line #3	16	1760		1:60	"
Pipe Line #3	Division	Wood	48	5280	159730	1:200	"
Cass	Wood	Alley			"	1:250	"

TABLE 11 a.(Cont'd)

STREET	FROM	TO	POPULATION	GAL. per DAY	TOTAL SEWAGE	GRADE	SIZE
Alley W. of Wood	Cass	North	108	11880	171610	1:250	8"
Exchange	Alley	Alley	36	3960		1:60	"
Alley E. of Wood	Cass	Exchange	66	7260		1:200	"
Exchange	Alley	Elizab.	24	2640	13860	1:100	"
Park	Division	Cass	114	12540		1.175	"
Cass	Elizab.	Park	18	1980		1:200	"
Park	Cass	Exchange	60	6600	21120	1:160	"
Exchange	Park	Elizab.	12	1320	22440	"	"
Elizabeth	Exchange	North	12	1320	37620	1:100	"
North	Elizab.	Alley	36	3960	41580	"	"
Pipe Line #3	North	J'ct.#1	78	8580	221770	1:150	10"
East Ave	Herman	Exchange	150	16500		1:90	8"
Exchange	Park	Selleck	24	2640		1:38	"
Cass	Limits	East	24	2640			"
East	Cass	Exchange	48	5280	7920	1:250	"
Exchange	Limits	East	24	2640		"	"
Exchange	East	Perry	24	2640	13200	1:250	"
Perry	Cass	Exchange	48	5280		1:100	"
Exchange	Perry	Selleck	24	2640	21120	1:250	"
Pipe Line #4	Exchange	J'Ct.#1	20	2200	42460	"	"
Pipe Line #5	J'ct.#1	J'ct.#2	96	10560	274790	1:320	10"
Pipe Line #5	J'ct.#2	Septic Tank			655940		12"

TABLE 11 b.

STREET	FROM	TO	VELOCITY Ft/sec.	LENGTH Feet	WIDTH Of Cut	AVERAGE CUT
Exchange	Limits	Lincoln	.95	885	20"	5.7
Jefferson	Peoria	Lincoln	.95	880	20"	10.5
Lincoln	Alley	Jefferson		195	"	7.6
Lincoln	Jefferson	Exchange	1.24	350	"	7.6
Exchange	Lincoln	Columbia	1.72	510	"	5.7
First	Peoria	Columbia	1.62	1410	"	10.9
Columbia	First	Exchange	1.90	670	"	8.9
Exchange	Columbia	Vincennes	2.01	80	"	5.7
Farm	Limits	Vincennes				
Vincennes	Farm	Division	2.17	1990	"	10.6
Mills	Exchange	Division	.87	760	"	8.9
Division	Mills	Vincennes	1.22	395	"	10.5
Vincennes	Division	Exchange	2.22	780	"	10.6
Exchange	Vincennes	Lumber	2.50	280	"	5.7
Lumber	Exchange	Second	2.64	980	"	13.7
Second	Peoria	Columbia	.95	1405	"	13.9
Columbia	First	Second		330	"	8.9
Columbia	Third	Second	1.68	260	"	8.9
Second	Columbia	Lumber		340	"	13.9
Lumber	Second	Third	2.36	250	"	13.7
Lumber	Fourth	Third			"	13.7
Third	Lumber	Pipe Line #1	2.36	200	"	15.1
Pipe Line #2	Limits	Herman	1.92	1750	"	10.2
Herman	Vincennes	Pipe Line #2	1.37	780	"	8.7
Pipe Line #2	Herman	Division	1.97	900	"	10.2
Alley W. of Benton	Cass	Division	1.37	320	"	10.6
Division	Alley	Benton	1.37	180	"	7.8
Division	Benton	Alley	2.00	170	"	7.8
Alley W. of Main	Division	Exchange	2.09	790	"	14.6
Exchange	Alley	Benton	2.09	175	"	16.4
Alley W. of Benton	Cass	Exchange	1.58	450	"	10.6
Exchange	Alley	Benton	1.58	170	"	16.4
Benton	Exchange	North	2.36	370	"	10.4

TABLE 11 b.(Cont'd)

STREET	FROM	TO	VELOCITY Ft/sec.	LENGTH Feet	WIDTH Of Cut	AVERAGE Cut
North	Main	Benton		325	20"	11.4
Benton	North	First	2.38	240	"	10.4
First	Main	Benton		310	"	7.1
First	Benton	Pipe Line #1	2.38	300	"	7.1
Pipe Line #1	First	Third	2.38	590	"	14.7
Pipe Line #1	Third	Alley	2.25	470	22 "	14.7
Alley No. of Linden	Pipe Line #1	Alley	2.25	365	"	15.5
Alley W. of Main	Linden	Alley		175	20"	12.9
Alley W. of Main	Alley	Fifth	2.25	175	22"	12.9
Fifth	Alley	J'ct #2	2.25	650	"	9.9
East Ave.	Burville	Crete	1.28	725	20"	10.9
Crete	East Ave	Austin	1.46	305	"	13.6
Austin	Burville	Crete	.95	725	"	11.2
Crete	Austin	Hewes	1.60	300	"	13.6
Hewes	Burville	Crete	.95	725	"	9.3
Crete	Hewes	Enterpr.	1.66	305	"	13.6
Alley E. of Main	Burville	Crete	.90	735	"	8.8
Crete	Alley	Enterpr.	.90	160	"	13.6
Enterpr.	Burville	Crete	.90	730	"	8.8
Pipe Line #3	Crete	Herman	2.26	1020	"	14.4
Herman	East Ave	Pipe Line #3	1.58	935	"	15.1
Pipe Line #3	Herman	Division	2.44	885	"	14.4
Division	Elizab.	Pipe Line #3		355	"	11.9
Pipe Line #3	Division	Wood	2.20	335	"	14.4
Cass	Wood	Alley	2.22	175	"	17.3
Alley W. of Wood	Cass	North	2.52	840	"	12.9

TABLE 11 b.(Cont'd)

STREET	FROM	TO	VELOCITY Ft/sec	LENGTH Feet	WIDTH Of Cut	AVERAGE Cut
Exchange	Alley	Alley		340	20"	9.3
Alley E. of Wood	Cass	Exchange	.95	550	"	10.3
Exchange	Alley	Elizab.	1.37	180	"	9.3
Park	Division	Cass	1.02	320	"	8.4
Cass	Elizab.	Park		270	"	17.3
Park	Cass	Exchange	1.62	620	"	8.4
Exchange	Park	Elizab.	1.62	280	"	9.3
Elizab.	Exchange	North	2.45	270	"	11.9
North	Elizab.	Alley	2.48	510	"	16.8
Pipe Line #3	North	J'ct #1	2.90	665	22"	14.4
East Ave	Herman	Exchange	1.44	1900	20"	10.9
Exchange	Park	Selleck		350	"	9.3
Cass	Limits	East				
East	Cass	Exchange	.84	780	"	7.2
Exchange	Limits	East		305	"	9.3
Exchange	East	Perry	.84	340	"	9.3
Perry	Cass	Exchange		730	"	10.6
Exchange	Perry	Selleck	1.51	340	"	9.3
Pipe Line #4	Exchange	J'ct #1	1.60	1420	"	15.2
Pipe Line #5	J'ct.#1	J'ct.#2	2.27	810	22"	10.5
Pipe Line #5	J'ct.#2	Septic Tank		140	24"	10.5

TABLE III*

SIZE	GRADE	DISCHARGE		VELOCITY
		Cu.Ft./Min	Gal./Day	Ft/Min.
8"	1:40	123.5	1330000	354
"	1:50	123.5	1330000	354
"	1:60	112.7	1270000	323
"	1:75	100.05	1077200	288
"	1:80	97:02	1056000	278
"	1:90	91.44	985000	262
"	1:100	86.55	932000	248
"	1:150	70.15	756000	201
"	1:160	67.71	731000	194
"	1:175	64.57	695000	185
"	1:180	63.52	684000	182
"	1:200	60.03	646000	172
"	1:220	57.58	620000	164
"	1:250	53.4	575000	153
"	1:270	51.3	552000	147
"	1:330	45.86	495000	131
"	1:350	44.32	476000	127
10"	1:100	152.1	1640000	279
"	1:150	122.6	1320000	225
"	1:320	82.19	886000	151
"	1:350	77.93	840000	143
12"	1:600	92.63	997000	118

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* This table compiled from Baldwin Latham's Tables #15 and #21.

Flushing and Ventilation.

Manholes, to take care of ventilation and to clean sewers were placed at street intersections and seldom more than 300 feet apart. Whenever manholes were more than 300 feet apart, lampholes were placed between them.

Whenever the calculated velocity was less than 2 feet per second a flushing manhole was provided for. At the beginning of pipe lines instead of dead-ends, flush-holes were used. Wherever future extension was considered probable, a flushing manhole was used instead of a flush-hole.

Details of manholes, flushing manholes, lampholes, and flush-holes are given on Plate 1V.

DESIGN OF PURIFICATION PLANT.

The fresh sewage from the mains before emptying into the creek is subjected to septic action in a settling tank. The septic tank is designed for a capacity of dry weather sewage for twenty-four hours. With an increase of sewage the time of septic action will decrease and about eighteen to twenty hours should be the minimum storage for septic action.

The flow of sewage into the tank should be continuous in order to provide sufficient food for the liquifying bacteria. If the velocity of flow is too great the bacteria will not have enough time to reduce the sewage. The velocity of flow through a tank should be greater than one inch per minute and should be at least one half inch per minute.

The sewer mains were designed to take care of the future growth of the town. In order to have sufficient velocity the septic tank was designed in small units. One unit to take care of the needs of the present population should be installed whenever the conditions would warrant.

The capacity of the unit tank was assumed as 70000 gallons per day.

70000/7.5 = 9350 cu. feet per day.

The velocity was taken as one inch per minute, giving 120 feet per day or five feet per hour.

9350/120 = 78 sq. feet.

The inside area was made about 6.5 feet by 12 feet. The length was assumed to be 100 feet, giving a storage of 100/5 = 20 hours.

Baffle boards were placed in the septic tank to reduce the velocity of flow and to keep the scum undisturbed. The layout of the septic tank with accessories is shown on Plate 111.

CONTRACT

AND

SPECIFICTIONS.

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of the Sewer -------------, in the Town of --------------------- until ---- o'clock -----, on the ------ day of ------,191-, for constructing sewers and septic tank in --------------
----

Forms of proposals, copies of the specifications, and instructions to contractors may be obtained of the Engineer; and the plans and profiles may be seen at his office.

Each bid must be accompanied by a deposit of $----- as a guarantee of the good faith of the bidder.

The Committee reserve the right to reject any or all bids.

Address, Sewer Committee,

Engineer.

TO CONTRACTORS.

All bids must be made upon the printed forms, to be obtained at the office of the Engineer, and enclosed in a sealed envelope, directed to the Engineer of Sewers, ---------------- and endorsed upon the outside of the envelope, PROPOSAL FOR CONSTRUCTING SEWERS AND SEPTIC TANK IN THE TOWN OF --------------

Each bid must be accompanied by a deposit of -----Dollars, to be left in the hands of the Town Clerk, subject to the conditions specified in the proposal hereto annexed, as a guarantee of the good faith of the bidder.

Bids shall state the price per lineal foot of pipes of each size laid, as herein specified, and for the various depths of trench named, also for all other items enumerated in the schedule opposite, which price shall be in full for all labor and materials required for the complete execution of the work.

All prices must be written in words, and also stated in figures.

The place of residence of each bidder must be given after his signature, which must be written in full. When firms bid, the individual names of the members shall be signed in full, and the firm name added.

The name of the contractor must be filled in the blanks left for that purpose.

The Town of ------------ reserves the right to reject any or all bids.

Bidders are requested to be present at the opening of the bids.

PROPOSAL.

FOR FURNISHING MATERIALS AND CONSTRUCTING SANITARY SEWERS, SEWER APPURTENANCES AND SEPTIC TANK IN CRETE, ILLINOIS.

Made by...

Residing in ....

To the President and Members of the Village Board of Crete,

Illinois .... do hereby declare that ....
.... the only person ....
interested in this proposal, and that no other person has any interest in this proposal, or in the contract proposed to be taken; that it is made without any connection with any other person, or persons or firms making proposals for the same work, and is in all respects without collusion or fraud. And ...... do further declare that no person acting for the employ of the town aforesaid is directly or indirectly interested in this proposal.

And...........do further declare............... have carefully examined the grounds on which the sewers are to be constructed, ...specifications and form of contract, and that .... will contract to furnish all materials, tools and labor required to perform and complete the work referred to in the Notice to Contractors, and more particularly described in the specifications, in the manner and on the conditions therein set forth, and in accordance with the further drawings, instructions and explanations to be given by the engineer explanatory thereof, upon the following terms and prices, towit;

For furnishing and laying complete each lineal foot of the several sizes of pipe designated, including specials and all necessary materials, excavations and back-filling.

12 inch standard strength vitrified sewer pipe......... ....

10 " " " " " " ....

8 " " " " " " ....

10 inch cast iron pipe................................. ....

8 " " " " ....

For constructing each man-hole with flushing device complete, including all extra excavation and materials........... ....

For constructing each plain manhole complete, including all extra excavation and materials ....

For constructing each manhole with drop complete, including all extra excavation and materials ....

For constructing each lamphole complete, including all materials ....

For constructing each flushhole complete, including all materials ....

For furnishing and putting in place, including all extra excavation and labor, each one thousand feet, board measure, of lumber or timber left in the trenches, by order of the engineer ....

For furnishing all materials including extra excavations and labor, and putting in place each cubic yard of extra concrete, actual solid measure........................... ....

For constructing the septic tank complete, including all extra excavation, materials and labor................... ....

For furnishing all materials, including all extra excavation, labor, etc., and building bulk-heads, and retaining walls complete, per cubic yard, actual solid measure ....

All extra work and materials are to be valued according to the engineer's estimate, plus 15% of such cost.

And .... hereby agree to enter into a contract within ten days from the date of your acceptance of this proposal, to finish and complete said work (by the ..... day of ....), according to the form hereto attached, and the plans and specifications on file in the office of the Engineer, under which the bid was made, and will furnish such sureties for the faithful performance of such contract, the payment for materials contracted for, and for the payment of laborers' wages, and liens which may arise therefrom, as shall be approved by the Village Board. In default of the performance of any of the conditions on... part to be performed, the sum of .... Dollars, which ...... have this day deposited with the Town Clerk, shall, at the option of the said Village Board, be absolutely forfeited to the Town of ....; but otherwise said sum of .... Dollars shall be returned to ......

Dated at ...., the ......day of ....191..
Signed..
(Address) ....
No.........   (State)........................

CONTRACT.

FOR THE CONSTRUCTION OF SANITARY SEWERS & SEPTIC TANK

AT CRETE, ILLINOIS.

This agreement, made and concluded this....... day of

..........191......by and between the Villiage Board of Crete,

Illinois, of the first part, and ....

of the second part, hereinafter called the contractor, witnesseth: The said party of the first part has let and awarded to the party of the second part, and in consideration of the covenants and agreements herein contained, on the part of the party of the second part to be kept and performed by .... hereby does let and award to the said party of the second part, the contract for furnishing all materials and labor required for the construction of that portion herein described of a system of sewers and septic tank in Crete, Illinois, according to the plans and specifications on file in the office of

....And the said party of the second part in consideration of the letting and awarding

to.......................... . of this work and contract, and in consideration of the payment hereinafter mentioned to be made

to..by the party of the first part, and under penalty expressed in a bond for

......................with sureties approved by the Village Board, bearing even date with these presents and hereunto annexed, hereby agree at........... own proper expense and cost to do all the work and furnish all the materials hereinafter set forth for the proper construction of the portion of a system of sewers hereinafter described, and to furnish

and complete the same on or before the.... .day of......191.. The work shall be begun within ten days after notice to begin has been sent to the contractor by the Village Board.

And the party of the second part further agrees that should the work of construction not be completed by the time aforesaid, the party of the first part shall have the right to employ men and purchase materials and complete the same. Should the cost

of such work and materials be less than the same figured at contract prices, the difference shall be paid to the said party of the second part by the party of the first part. But should the cost be more than the contract prices, the difference of cost shall be deducted from any money due the party of the second part, by the party of the first part; or, should the money due and retained be insufficient, the same will be a charge upon the bond accompanying this agreement.

And it is further agreed that the said Village Board shall be, and are hereby authorized to appoint an engineer of said sewer works and the necessary number of inspectors for the work, all as provided for in the specifications hereto attached.

To prevent all disputes and litigation, it is further agreed by and between the parties to this contract that the engineer so appointed by the Village Board aforesaid, as provided for in aaid specifications, shall in all cases determine the fulfillment of this contract; estimate, compute and determine the amounts of money due the contractor for executed work done under the terms of this contract; and he shall decide all questions which may arise relative to the execution of this contract on the part of the contractor, and the quality of the materials to be used by the contractor in the execution of this contract. The estimates, directions, and decisions of the engineer shall be final and conclusive.

The approximate amount of the work to be done is shown in a

certain map and certain profiles filed ....

.... The Village Board reserves the right to increase or diminish the amount of work to be done to any extent not greater than one-half the money value of the entire work.

The party of the second part shall perform such extra work as the engineer may deem necessary for the proper completion of the work.

The engineer shall estimate the actual cost of such extra work with the addition of fifteen percent, as profit and compensation for the wear of tools. But no single piece of extra work of which the money value is more than fifty dollars shall be done by the contractor except by the direct order of the Village Board and communicated to him through a written notice from the engineer. No work that can be classified or paid for under this contract shall be classed as extra work. It is understood that whenever "Specifications" are mentioned, the specifications adopted by said Village Board on file in

....are referred to, of which a copy is hereunto attached, which are also a part of this contract.

It is further agreed that the contractor shall keep the surface of the streets wherein sewers are constructed, in repair for a period of six months from the date of completion and acceptance of this work. It is further agreed that the contractor shall, upon the completion of the work and when the final estimate therefor shall have been made by the city civil engineer,. as provided by law, execute a bond in the sum of ten percent of the total cost, at contract prices, of the work done under this contract. The said bond shall be executed with ample surety, subject to the approval of the Village Board, and conditioned that the said contractor will keep in repair, to the satisfaction and approval of the said Village Board, the surface of the streets wherein he has constructed a sewer or sewers, for a period of six months from the date of said bond, and the said bond shall bear even date with the date of the engineer's certificate of the completion of the work.

If at any time after the completion of the work and its acceptance by the Village Board and before the expiration of the six months period as provided above, the surface of the streets should require repairs, the Village Board shall notify the contractor, either in person or by mail, to make such repairs. Should the contractor fail to begin the work of making the repairs required within ten days after the date of such notice the Village Board shall cause the said repairs to be made, and the cost thereof shall be a charge against the bond above provided for and, in order to the full and complete carrying out of all the agreements, stipulations and conditions of this contract, the contractor shall leave his permanent post office address with the town clerk of Crete, Illinois .

It is agreed that the said contractor shall hold the said Village Board harmless against all claims for labor done or materials furnished on account of this contract, and shall furnish satisfactory evidence whenever called upon to do so, that all such claims have been paid.

The contractor shall be responsible for all damages to life or property due to work performed by him in the construction of the sewers, and shall indemnify and save harmless the said Village Board from all suits or actions of every name and description brought against the said Village Board for or on account of any damages received or sustained by any party or parties by or from the said party of the second part, his servants or agents in the construction of said sewers, or by or in consequence of any negligence in guarding the same, or any improper materials used in its construction, or by or on account of any act or omission of the said party of the second part or his agents, and for the faithful performance of this contract by the party of the second part. The said party of the second part hereby further agrees that so much of the money due to him under and by virtue of this agreement as shall be considered necessary by the said Village Board may be retained by them until all such suits or claims for damages, as aforesaid, shall have been settled and evidence to that effect furnished to the satisfaction of the said Village Board.

If the engineer should at any time be of the opinion that the work is unnecessarily or unreasonably delayed, or that the contractor is not on his part fulfilling this contract, or that the force employed is not sufficient to complete the work within the time herein provided, and should so certify to the said party of the first part in writing, and said first party shall thereupon require said second party to proceed without delay with such force as they shall direct, and in case of his refusal or neglect to comply with such requirement, the said first party may take possession of and complete the work at the expense of said contractor as herein provided in case of failure to complete the work. But should the work be delayed or interrupted by order of the Village Board after the service of such notice, the contractor shall be entitled to an extension of time equal to the time of such interruption or delay, which shall be determined by the engineer. The time of beginning, rate of progress and time of completion being essential conditions of this contract; and if the contractor shall fail to complete the work by the time above specified, the sum of ten dollars per day thereafter until such completion, as liquidated damages for such failure, shall be deducted from the monies payable under this contract. This sum shall be in addition to any penalties otherwise specified, and shall be paid by said party of the second part to the party of the first part, in the event of a failure to complete said work as herein agreed, and in no event as a penalty, but to the full amount thereof and in addition to any other damages sustained or agreed upon.

No variation from the regular prices made in this proposal will be allowed. The Village Board will not consider themselves bound to notify or inform contractor where material that is hard or expensive to excavate occurs or will be liable to be encountered.

No charge shall be made by the contractor for hindrance or delays from any cause during the progress of any portion of the work embraced in this contract.

The said party of the second part hereby agrees that he will give his personal attention to the fulfillment of this contract and that he will not sublet the aforesaid work but will keep the same under his control, and that he will not assign by power of attorney or otherwise any portion of said work, unless by and with the previous consent of the Village Board, to be signified by endorsement on this agreement.

And the said party of the second part hereby agrees to receive the prices named in the above proposal as full compensation for furnishing all materials, and for the use of all tools, forms and other implements, and for all labor in moving materials and executing all the work contemplated in this contract, for all bailing and draining and for all loss and damage arising out of the nature of the work aforesaid, or from the action of the elements or from any unforseen

obstacles or from difficulties which may be encountered in the prosecution of the same; and also for all expenses incurred by or in consequence of the suspension or discontinuance of said work--in case the Village Board shall so direct and for well and faithfully completing the work and the whole thereof in the manner and according to the plans and specifications and the requirements of the engineer under them.

Payments for the work shall be made monthly upon the estimate of the Engineer........ per cent. of the amounts due will be retained as a guarantee against poor workmanship and materials. One-half of this reserve will be paid as soon as the work is completed and accepted, and the other half at the expiration of one year after the acceptance of the work.

Now, Therefore, in consideration of the payments and covenants hereinafore mentioned to be made and performed by said party of the first part, the said .... herby covenants and agrees to do the work above mentioned in a substantial and workmanlike manner, in conformity with the plans, profiles, and specifications of such work on file in the office of the Engineer, in strict obedience to the directions which may from time to time be given by the said Engineer or his duly authorized assistants, and in accordance with the following specifications:

SPECIFICATIONS FOR SEWERS.

In the Town of ....

SEWER PIPES.

The sewers shall be constructed of first quality vitrified, salt-glazed sewer pipe, sound and well burned throughout their thickness, impervious to moisture, of smooth and well glazed exterior and interior surfaces, free from cracks, flaws, blisters,, fire-checks, and all other imperfections, circular in the bore, of true form in their lengths, whether straight or curved, internally of the exact specified diameter, and of uniform standard thickness.

All pipe shall be socket pipe, with true and circular sockets, concentric with the bore of the pipe, and shall be furnished in pieces two feet long. for all junction pieces, a well fitted vitrified stopper shall be furnished, without charge.

A Y branch connection, of four inches in diameter, shall be provided opposite every lot of .....feet in width in front of which it passes.

IRON PIPE.

Iron pipe shall be used where the sewer runs under or through waterways-either natural or artificial-or under a railroad, or wherever it is deemed necessary by the Engineer. The joints shall

be of lead, properly caulked. The lengths of pipe, their diameter and thickness to be as directed by the Engineer. The weight of each pipe shall be plainly marked on it before leaving the factory.

The iron pipe shall be paid for by the ton, laid in place with joints complete.

LOCATION.

The sewers shall be located on the lines shown on the plans of the work, and will be staked out by the Engineer. This line, whenever practicable, will be on the centre line of the street. The committee, however, reserve the right to move the line of sewers to the right or left whenever obstructions are met which render a change of line desirable.

The contractor will be required to preserve all stakes and bench marks until permission is given by the Engineer to remove them.

The line for trenches will be indicated by stakes set at one side of the trench. A width of at least two feet on the side of the trench where the stakes are, shall, as the work progresses kept free from obstruction.

EXCAVATION.

All excavation shall be by open cut from the surface. No tunneling will be allowed, except written permission be previously obtained from the Engineer.

The contractor will be required to keep the sides of the excavation vertical, by bracing or otherwise; but no allowance will be made therefor unless the same is left in the trench by written order of the Engineer.

The excavation, at the bottom, is to be made and shaped as nearly as possible to fit the lower half of thepipe to be laid, with holes cut at the joints for the sockets to rest in, so that the pipe shall have a uniform bearing on the ground from end to end. The excavation at the joints shall be at least six inches outside of the joints to enable the joints to be perfectly cemented.

At the height of half the diameter of the pipe from the bottom, that is, at the height of the greatest horizontal diameter of the pipe, all trenches are to be twelve inches wider than the greatest diameter of the pipe to be laid therein.

The trench shall be dug to within six inches of grade by measurement from the witness stakes on the surface. The last six inches shall be taken out after the grade pegs have been set in the bottom of the trench by the Engineer.

The excavations for all manholes, flush-tanks, and other accessories shall be sufficient to leave at least one foot in the clear between their outer surfaces and the embankment or timber which may be used to protect it.

The approximate depth of the cutting will be given by the Engineer before the excavation is begun. Grade and line will be given by the Engineer every 12-1/2 or 25 feet at the bottom of the trench, on stakes to be set by the contractor.

In no case, without previous written permission from the Engineer, shall more than ....feet of trench be opened in advance of the completed sewer.

The material excavated shall be laid compactly on the sides of the trench and kept trimmed up so as to be of as little inconvenience as possible to the traveling public and adjoining tenants.

The contractor shall not obstruct the gutter of any street, but shall use all proper measures to provide for the free passage of surface water along the gutters.

The contractor shall provide for all water courses and drains interrupted during the progress of the work, and replace them in as good condition as he found them.

The contractor shall keep the trenches free from water during the progress of the work, as no pipe will be laid in water in any case whatever.

No additional compensation shall be allowed for excavating manholes, or flush-tanks over the price per lineal foot for trench.

PROTECTION OF WATER AND GAS-PIPES, ETC.

The contractor shall do whatever may be necessary to keep in position and to protect from injury all water and gas pipes, lamp posts, service pipes, and all other fixtures which may be met with in carrying on the work.

In case any of the said gas or water pipes or other fixtures be damaged, they shall be repqired by the parties having control of the same, and the expense of such repairs shall be deducted from the amounts which may become due the contractor.

PROTECTION AGAINST ACCIDENTS.

The contractor shall erect suitable barriers around all excavations, to prevent accidents to passengers on the streets, and shall place and maintain during the night sufficient red lights on or near the work.

The contractor shall have charge of, and be responsible for, the entire line of sewers for whose construction he has contracted, until their completion and acceptance.

BACK-FILLING.

The earth filled around and on top of the pipes shall be free from stone, and tamped with the utmost care, so as to obtain the greatest compactness and solidity possible. In filling, the earth shall be kept at the same height on both sides of the pipe. The earth shall be rammed in layers of not more than one foot thick up to the surface of the street, and in no case shall the number of men filling be more than twice the number of men ramming.

The contractor, without a written permission from the Engineer in charge, is required not to sell, remove, or permit to be removed from the line of the work, before the trench shall have been refilled, any sand, gravel, or earth excavated therefrom which may be suitable and required for refilling.

The trench must in all cases be filled to the proper grade with suitable material, free from stones over four inches in diameter. Should there be a deficiency of proper material for refilling the trench, the contractor will be required to furnish the same at his own cost.

REPAVING AND RESTORING STREETS.

Where the pavement has been removed, it must be replaced by the contractor and left in as good condition as it was before being removed.

As the trenches are filled in and the work completed, the contractor shall remove all surplus material, without additional compensation, to localities not interfering with the regulations of the town, and shall leave all roads and places free, clean, and in good order.

All work of restoring the surface of the street shall be done to the satisfaction of the Superintendent of Public Streets.

EMBANKMENT.

Where embankment is necessary to support the foundations of the sewer, or to cover or protect it in any way, it shall be made of the width and slopes as shown onthe plan. The surface of the ground receiving the embankment shall be carefully cleared of all muck or unsuitable material, of whatever nature.

The embankment shall then be formed of good loam or gravel, free from all stones over four inches in diameter, and of those below that size in a proportion not exceeding one part of stone to three parts of earth in any place.

If built to support the foundation of the sewer, the material is to be deposited in layers of not more than six inches

in thickness, each layer to be separately compacted by heavy iron rollers, or, where these cannot be used, by heavy pavers' rammers. No breaks, steps, or irregularities in the distribution of material or formation of the layers will be allowed, and the whole embankment is to be carried up evenly so as to make a compact and solid foundation.

PROTECTION OF PROPERTY.

The contractor shall, at his own expense, shore up, protect, and make good, as may be necessary, all buildings, walls, fences or other property injured, or liable to be injured during the progress of the work; and the contractor will be held responsible for all damage which may happen to neighboring property from neglect of this precaution, or from any other cause connected with the prosecution of the work.

PIPES-HOW LAID.

All pipes over eight inches in diameter shall be laid with a straight edge. One end of the straight edge shall be placed on the nearest grade peg and the other on the flow line of the pipe already laid, and the pipe shall be so adjusted as to be in contact with the straight edge throughout its length.

All pipes less than eight inches in diameter shall be laid in the following manner: A mason's line shall be tightly stretched parallel to the grade and slightly above the sockets of the pipes. This line will be supported over the centre at points not more than twenty-five feet apart. The exact grade for each pipe shall be obtained by measuring down from this line to the invert of the sewer.

Especial care must be taken to lay the pipe to the exact grade and line.

All pipes, previous to being lowered into the trench, shall be fitted together and matched, so that when jointed in the trench they may form a true and smooth line of pipes. No pipes shall be trimmed in any case, Pipes which do not fit truly shall be rejected.

JOINTS.

A gasket of oakum or other material approved by the Engineer shall be pressed into the joint around the entire circumference of the pipe to prevent the entrance of cement to the inside of the pipe. No joint shall be cemented until the gasket of the next joint in advance has been completed.

The cement shall be pressed into the space between the socket and spigot so as to entirely fill the space, and the bevel joint at the end of the socket shall be smoothly and evenly made.

Special care must be taken to make perfect joints at the bottom of the pipe.

The excavation made for the socket of the pipe shall be filled with sand to support the cement firmly in position. When water accumulates in this excavation it must all be removed before the joint is made.

When the joint is completed, great care must be taken not to disturb the pipes.

CEMENT.

The cement for filling the joints shall be pure, fresh-ground ....cement, of best quality, with only enough water added to give it the proper consistency, and shall be mixed only as needed for use.

BRANCHES, "T's." Etc.

The "Y" braches, "T's," lamp-holes, hand-holes, and manholes shall be placed at points indicated by the Engineer. They shall not be covered until he has noted and recorded their exact position. The "Y" branches shall be elevated to correspond to the lateral sewers and house drains entering them. They shall be closed with an earthenware cap, and the space above the cap shall be filled with sand, covered with a thin coating of cement.

SPECIAL PIECES.

Special pieces, such as Y branches, curves, T's, etc., shall be made according to drawings furnished by the Engineer.

SEWERS TO BE KEPT CLEAN AND FREE FROM WATER.

All the pipes must be kept thoroughly clean, and no water will be allowed to flow through them in any case whatever, during the construction of the sewers.

When the trench is left for the night, or the pipe-laying is stopped by rain storms or any other cause, the ends of the sewer must be closed water-tight with a plug and cement, or with bricks and cement, as the Engineer may direct.

When running quicksand or other treacherous ground is encountered, the work shall be carried on day and night, should the Engineer so require.

ARTIFICIAL FOUNDATION.

Whenever ordered by the Engineer, in writing, the contractor shall excavate to such depth below grade as the Engineer may direct, and the excavation shall be brought to grade with such material as shall be ordered by the Engineer; the extra work to be paid for upon the estimate of the Engineer.

If the contractor excavate below grade without orders, he will be required, at his own expense, to fill the excess of excavation with such material as the Engineer may direct.

Concrete foundation shall be placed under the flush-tanks and manholes.

ROCK CUT.

In rock cut, the rock shall be taken out of the trench to a depth of six inches below the bell of the pipe when laid. The refilling from the bottom of the trench to one foot above the bell of pipe shall be of earth, free from stones, or such material as shall be approved by the Engineer.

When blasting is resorted to for making the excavation, the trench shall be covered carefully on the top and sides with heavy timbers and plank, to prevent fragments of rock from being thrown out.

All damages or injury to persons or property resulting from blasting operations, or from neglect in properly guarding the trenches, must be paid by the contractor; and no compensation to said contractor for losses thus incurred will, under any circumstances, be allowed.

When the excavation for any sewer is made through rock, enough earth must be drawn, in refilling the trench, to replace the volume of stone removed, as the latter will not be permitted to be thrown back. The compensation for this labor must be included in the regular price bid for the sewer.

LAMP-HOLES.

Lamp-holes shall be constructed by placing a six-inch "T" branch vertically in the sewer, and bringing it up to within one foot of the street surface by adding pipes of the same diameter. The top of the lamp-hole shall be protected by a cover, as shown in the detail drawings.

MANHOLES.

The manholes shall be constructed of hard brick, laid in cement mortar, and plastered outside and inside with cement mortar. The thickness of the wall shall be eight inches. The form shall be a truncated cone (see drawings). The bottom shall be formed of concrete, and the top of the concrete shall be on a level with the bottom of the sewer pipe, and the top of the cover on a level with the street surface. Particular care must be taken in forming the bottoms of manholes to make the curves, of tributary sewers, as easy as possible. The top shall be covered with a perforated cast-iron cover, with dust-pan underneath.(See drawings.)

Iron steps of dimensions shown in the drawing are to be built into the brick work 15 inches apart vertically, unless otherwise indicated in the drawing. They shall be galvanized,

or coated with red lead paint or coal tar varnished.

FLUSH-MANHOLES.

Flush-manholes shall be constructed as specified in the paragraph on "MANHOLES," with the addition of flushing device as shown in the drawing.

FLUSH-HOLES.

Flush-holes shall be constructed by carrying up pipe from a "Y" in the sewer as shown upon the plans. Should be depth of the sewer or the nature of the ground demand it, the engineer may order the pipe supported in brick-work to prevent the crushing of the sewer. An iron ring and cover weighing not less than 250 pounds shall be placed on a brick foundation as shown upon the plans. All pipe entering into the construction of flush-holes shall be eight inches in diameter.

BRICK MASONRY.

None but the best quality of whole, sound, perfect brick, burned hard entirely through, shall be used. They are to be culled when delivered upon the ground, and all bats and imperfect bricks are to be immediately removed from the work.

All bricks are to be thoroughly wet immediately before laying. Every brick is required to be laid in a full and close joint of cement mortar, on its beds, ends and sides, at one operation. In no case is mortar to be slushed in afterwards.

CEMENT MORTAR.

The mortar for brick work shall be made by carefully measuring and thoroughly incorporating one (1) part of Portland cement with two(2) parts of clean, sharp sand in dry state, mixing with clean water to the proper consistency, and shall be used while fresh, and the use of mortar which has set and then been retempered will not be allowed. The mortar used in laying pipe sewers shall consist of one (1) part of Portland cement and one (1) part of clean sand mixed and used as above specified, all to be furnished by the contractor without extra charge.

The mortar for brick work at the outfalls of sewers for a distance equal to ten times the internal diameter of the sewer shall be made of one part of Portland cement and one part of clean, sharp sand.

Portland cement shall be ground so that ninety-two (92) per cent will pass through a standard sieve of one hundred(100) meshes to the lineal inch, and when mixed, one (1) part cement and three (3) part sand, shall show a tensile strength of two hundred (200) pounds per square inch in seven days-one day in air and six days in water-and an increase of not less than twenty (20) per cent in strength at the end of twenty-eight days, and an additional increase of fifteen (15) per cent at the end of three months.

As ample time is required for making tests, the contractor shall submit samples of the cement he desires to use, and one or more brands may be approved by the Engineer, any of which the contractor may use.

Sand shall be sharp, clean, and not of excessive coarseness. It shall particularly be free of particles of slate and loam.

CONCRETE.

All concrete shall contain torpedo sand amounting to one-half (1/2) of the volume of the broken stone or gravel; and seven (7) cubic feet of concrete in place shall contain ninety-four (94) pounds of Portland cement.

The stone shall be of good quality, graduated in size, angular in shape and free from dirt or clay. All stone shall be crushed and screened so as to pass through a screen having openings one and one-half (1-1/2) inches in diameter and to pass over a screen having openings one-half (1/2) inch in diameter.

MATERIALS.

All materials shall be furnished by the contractor and shall be subject to inspection and acceptance by the Engineer.

LENGTH OF SEWER.

The length of the sewer will be measured on the centre line of the pipe.

INSPECTION.

All the work contemplated by these specifications shall be done to the satisfaction of the engineer, and all materials and workmanship of whatever description furnished and performed by the contractor or contractors shall be subject to the inspection and rejection of said Engineer. Whenever unfaithful or imperfect work is discovered, it shall be corrected and repaired immediately upon the requirement of the Engineer, notwithstanding that it may have been passed over or overlooked bythe inspector. The inspection of the work is not intended to relieve the contractor from any of his obligations to perform sound and reliable work as herein described.

CHANGES OF GRADE.

If, during the construction of the work, it is found necessary to change the grade of any sewer, the difference in cost occasioned by such change shall be added to or deducted from the contract price of the work, as the case may be, and this difference shall be ascertained by the Engineer in the same manner as provided for extra work; but no change in grade which amounts to less than one foot in depth shall be considered to be covered by this specification.

DEFINITIONS.

Wherever in these specifications the word engineer is used, it shall be taken and held to mean the civil engineer employed and appointed by the Village Board, to take and have charge of the construction of the work herein specified.

Wherever in these specifications the word contractor is used, it shall be taken and held to mean the party, parties, firm, corporation, or company to whom has been awarded the contract for this work or any part thereof.

Wherever in these specifications the word inspector is used it shall be taken and held to mean the person or persons employed and authorized by the Village Board to immediately supervise the work herein specified.

Wherever in these specifications the words Village Board are used they shall be taken and held to mean the then duly elected and qualified Village Board of the village of Crete, Illinois.

BULKHEADS AND RETAINING WALLS.

All bulkheads and retaining walls shall be built of good lime or sand stone laid in cement mortar. No stone which is less than four inches thick shall be used. The stones shall be laid headers and stretchers in regular courses on full mortar beds, with joints properly broken and the different courses tied together and securely bonded in all directions. After the work is laid the joints shall be cleaned, scraped and wetted and then pointed with mortar, composed of equal parts of Portland cement and sand. This pointing shall be of bead form and must be neatly and carefully done. Stone for coping must be six inches thick and must extend or project over the ends, face and back of wall at least four inches. The engineer may require this coping to be put together with dowel pins made of 3/4-inch round iron and clamps or binding irons made of 3/8-inch by 1-1/2-inch iron bar. In all cases these bulkheads must be built up to and around the brick sewer or sewer pipe as the engineer shall direct.

GENERAL STIPULATIONS.

The contractor shall start the work at and from such points on the line of the sewer as the Engineer may from time to time direct.

No pipes or masonry will be allowed to be laid in freezing weather.

The contractor shall also do such extra work in connection with his contract as the Engineer may in writing

specially direct, and in a first class manner, at a price to be fixed by said Engineer; but no claim for extra work shall be allowed unless the same was done in pursuance of a written order, as aforesaid, to do the work as such and at a price previously fixed, and the claim presented at the first estimate after the work was done.

The contractor, upon being so directed by the Engineer, shall remove or rebuild, or make good, at his own cost, any work which the latter shall decide to the deficiently executed.

The contractor will be required to observe all City Ordinances in relation to obstructing streets, keeping open passage ways, and protecting the same where exposed, and, generally, to obey all Ordinances, Rules, and Regulations controlling or limiting those engaged on the work.

A watchman shall be employed on the work at night whenever in the opinion of the Engineer it shall be necessary.

If any person employed by the contractor on the work shall appear to the Engineer to be incompetent or disorderly, he shall, on the requistion of the Engineer, be immediately discharged, and such person shall not be again employed upon the work without the permission of the Engineer.

In witness whereof the said party of the second part have hereunto set their hand and seal,and the said party of the first part has caused these presents to be sealed with its common seal and to be signed by the ....

....

on the day and year above written.

SPECIFICATIONS FOR SEPTIC TANK.

EXCAVATION.

Excavation should be made to lines as shown on the plans. The walls and floor of the excavated pit shall be thoroughly tamped.

It is understood that all prices for concrete masonry shall include furnishing all materials, necessary forms and falsework, tools, labor, excavation and incidental work necessary properly to place the concrete.

PLANS.

All concrete masonry shall be built to the dimensions as shown on the plans furnished or approved by the Engineer, and which are a part of these specifications.

The concrete shall be of the character indicated on the plans or as provided for in these specifications, and shall be built by the contractor in accordance therewith.

CEMENT.

The cement shall be a standard brand of Portland cement which has been in practical use on public works for not less than three (3) years, and shall have proved satisfactory therein. No brand shall be used which the Engineer deems unfit for the work or which does not conform to the requirements of the specifications of the American Society for Testing Materials, as adopted August 16, 1909, when tested in accordance with the methods proposed by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers presented at the society January 21, 1903, amended January 20, 1904, and January 15, 1908, with all susequent amendments thereto.

One bag of cement will be considered as having a volume of 0.95 cubic feet.

The contractor shall notify the Engineer in writing what brand or brands he intends to use, and before ordering the cement shall receive the written approval of the Engineer as to the brand selected. It is understood that such approval merely covers the selection of the brand; that the cement itself may be rejected if it fails to meet the requirements herein specified.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The contractor shall provide sufficient means to protect the cement against dampness, and no cement shall be used which has become caked.

WATER.

Clean water shall be used in mixing concrete and shall be free from oils, acids or alkalis.

SAND.

Sand shall be composed of clean, coarse quartz, or other equally hard and durable grains, passing, when dry, a screen having 1/4 inch openings.

The grains shall be graded in size from fine to coarse, but not more than 15 per cent by volume shall pass a sieve having 50 meshes to the inch. It shall not contain more than 3 per cent by dry volume of clay.

Sand containing organic matter shall not be used in the work.

STONE.

Stone used for concrete work shall consist of crushed rock or gravel stones screened to the sizes herein specified and shall consist of clean, sound, hard and durable material.

No weathered or disintegrated material shall be used.

PROPORTIONS.

The concrete shall consist of one (1) part of cement, two (2) parts of sand and four (4) parts of broken stone.

MIXING BY HAND.

Tight platforms shall be provided of sufficient size to accommodate men and materials for the progressive and rapid mixing of at least two batches of concrete at the same time. Batches shall not exceed one cubic yard each, and smaller batches are preferable, based upon a multiple of the number of sacks to the barrel.

Spread the sand evenly upon the platform, then the cement upon the sand, and mix thoroughly until of an even color. Add all the water necessary to make a thin mortar, and spread again; add the gravel if used, and finally the broken stone, both of which, if dry, should first be thoroughly wet down.

Turn the mass with shovels or hoes until thoroughly incorporated, and until all the gravel and stone is covered with mortar, which will probably require the mass to be turned four times.

Another method, which may be permitted at the option of the engineer in charge, is to spread the sand, then the cement, and mix dry; then the gravel or broken stone, add water, and mix thoroughly as above.

PLACING.

All concrete shall be carefully deposited in place in such a manner that the stone and mortar are not separated.

As fast as concrete is deposited, it shall be thoroughly settled by spading or other means to bring the mortar in thorough contact with the forms and reinforcing steel.

If possible, the entire floor slab of wholetank shall be poured continuously.

If at any time the work is interrupted so that the concrete already deposited has attained final set, the surface of such concrete shall be chipped off for a sufficient depth to expose the coarse aggregate, the loose material swept or washed away, the surface thoroughly wetted, and flushed with a thin 1 to 2 mortar before concreting is resumed.

Concrete cover on septic tank shall be kept protected from the direct rays of the sun by means of canvas, straw or other means approved by the Engineer, and shall be kept continually wet for a period of one week after placing the same.

Concrete to be left above the surface of the ground or water shall not be constructed during freezing weather except on the express written consent of the Engineer, and it shall be protected in the manner ordered by the Engineer. In this case, water and broken stone shall be heated; and in severe cold, salt shall be added in theproportion of about two (2) pounds per cubic yard, but no salt shall be used for reinforced concrete. It is understood, however, that any concrete laid during freezing weather shall be entirely at the risk of the contractor, and concrete showing injury by frost shall be removed and replaced at the expense of the contractor.

FORMS.

The contractor shall provide all necessary material and means for building the forms for all concrete masonry.

All forms shall be so constructed as to be held rigidly to place, line and elevation. If at any point of the work, after the concrete has been placed, the forms show signs of bulging or sagging, that portion of the concrete shall be immediately removed on notice by the inspector, and the forms shall be properly supported.

The amount of concrete to be removed shall be determined by the inspector, and no extra allowance shall be made to the contractor for such work.

All forms are to remain in place until in the opinion of the Engineer it is safe to remove them.

Moulding having 3/4 inch or 1 inch sides shall be used on all exposed corners. The surface of such moulding in contact with the concrete may be rounded to a uniform radius or may be flat. In the latter case the resulting angles between adjacent surfaces in the finished concrete shall be equal.

Forms shall be given a bevel of 1 inch to 1 foot wherever projections of the concrete, such as copings, would otherwise cause binding upon the removal of the forms. The pitch shall be so arranged as to increase the thickness of the projections at the base, and the narrowest parts of such projections shall have dimensions not less than as shown on the plans.

FINISH.

The forms covering what will be the exposed face of the concrete masonry shall be removed as soon as the Engineer decided that it is safe to do so, and all crevices neatly filled with a stiff 1 to 2 cement mortar thoroughly rammed into place.

All exposed faces shall be covered with a 1/2 inch layer of neat cement and shall be treated by tamping and trowelling in such a manner as to flush the cement to the surface, and to provide a smooth and even surface, free from pits and porous places.

REINFORCING STEEL.

Unless otherwise shown on drawings, all steel for reinforcing concrete shall consist of plain square section bars or deformed bars of a type to be approved by the Engineer.

The size of all steel reinforcement as indicated on the drawings is the side of a square equivalent to the required net section.

The steel bars shall be distributed in the concrete in the exact positions and have the net sectional erea provided in the drawings. In general, they shall be securely wired or otherwise fastened in place before concrete is deposited.

Unless otherwise specified, all steel for reinforced concrete shall be mild or medium steel with an elastic limit of not less than 32,000 pounds per square inch. Steel bars shall stand bending cold with a radius equal to twice their diameter through 180 degrees without fracture.

No rerolled material or high carbon steel shall be used on the work.

All bars must be obtained in the full length indicated on the plans.

Before steel is placed in the concrete, it shall be free from grease, dirt or rust, and the contractor shall provide means on the work for properly cleaning the steel.

Special care shall be exercised to insure thorough contact of the concrete with every portion of the surface of the steel reinforcement.

BOND.

Know all men by these Presents, That we -------------- -- -- are held and firmly bound unto the Village of ------------- in the sum of ------------------------------------Dollars, lawful money of the United States of America, to be paid to the said Village of --------------------, or to its certain attorney or assigns, to which payment, well and truly to be made, we bind ourselves, our heirs, executors, and administrators, and each and every of them, firmly by these presents.

Signed and sealed with our seals, and dated at---------- -------------------this-----------day of ---------------191-.

The Condition of this Obligation is such, That Whereas, the said --- ha---entered into a contract with the Village of ---------- --------,bearing date the -----------day of ------------191-, which said contract is hereunto attached.

Now, Therefore, If the said-------------------------- shall well and truly keep and perform all the terms and conditions of said contract, on----------- part to be kept and performed, and shall indemnify and save harmless the said Village of

-------------------------,as therein stipulated, then this obligation shall be of no effect, but otherwise it shall remain in full force and virtue.

ESTIMATE OF COST.

COST OF SEWER.

Cost of Sewer Pipes.

19,553	lengths of 8" pipe	@	36¢	----	$7,039.08
1, 543	" " 10" "	@	54¢	----	833.22
70	" " 12" "	@	72¢	----	50.40
600	ft. of 8" cast iron pipe	@	47¢	----	282.00
50	" "10" " " "	@	63¢	----	31.50
					$8,236.20

The cost of vitrified pipe is 70% off list price, plus 20% for branching.

Cost of Trenching.

8" pipe.
Average cut -- 11.8 ft.

$$\text{Total Excavation} -- \frac{11.8 \times 39706 \times 20}{12 \times 27} = 28{,}900 \text{ cu. yds.}$$

10" pipe.
Average cut -- 11.2 ft.

$$\text{Total Excavation} -- \frac{11.2 \times 3135 \times 22}{12 \times 27} = 2{,}380 \text{ " "}$$

12" pipe.
Average cut -- 6 ft.

$$\text{Total Excavation -- } \frac{6 \times 140 \times 24}{12 \times 27} = \underline{62 \text{ cu. yds.}}$$

31,342 cu. yds.

31,342 cu. yds. @ 50¢ per cu. yd. --- $15,671.00

Cost of Laying Pipe.

39,705 ft.	@ 8¢ ----	$3,176.40
3,135 "	@ 10¢ ---	313.50
140 "	@ 12¢ ---	16.80
		$ 3,506.70

The price of one cent per inch of diameter of pipe per lineal foot laid, includes hauling, labor of laying, and cement for joints.

Cost of Accessories.

Manholes ------------	41	@	$35.00 -----	$1,435.00
Flushing Manholes ---	61	@	$36.00 -----	$2,196.00
Lampholes ----------	16	@	6.00 -----	96.00
Flush-holes ---------	18	@	6.00 -----	108.00
				$3,835.00

SUMMARY.

Cost of Pipes ----------------------	$ 8,236.20
Cost of Trenching ------------------	15,671.00
Cost of Laying Pipe ----------------	3,506.70
Cost of Accessories ----------------	3,835.00
Total Cost of Sewers	$31,248.90

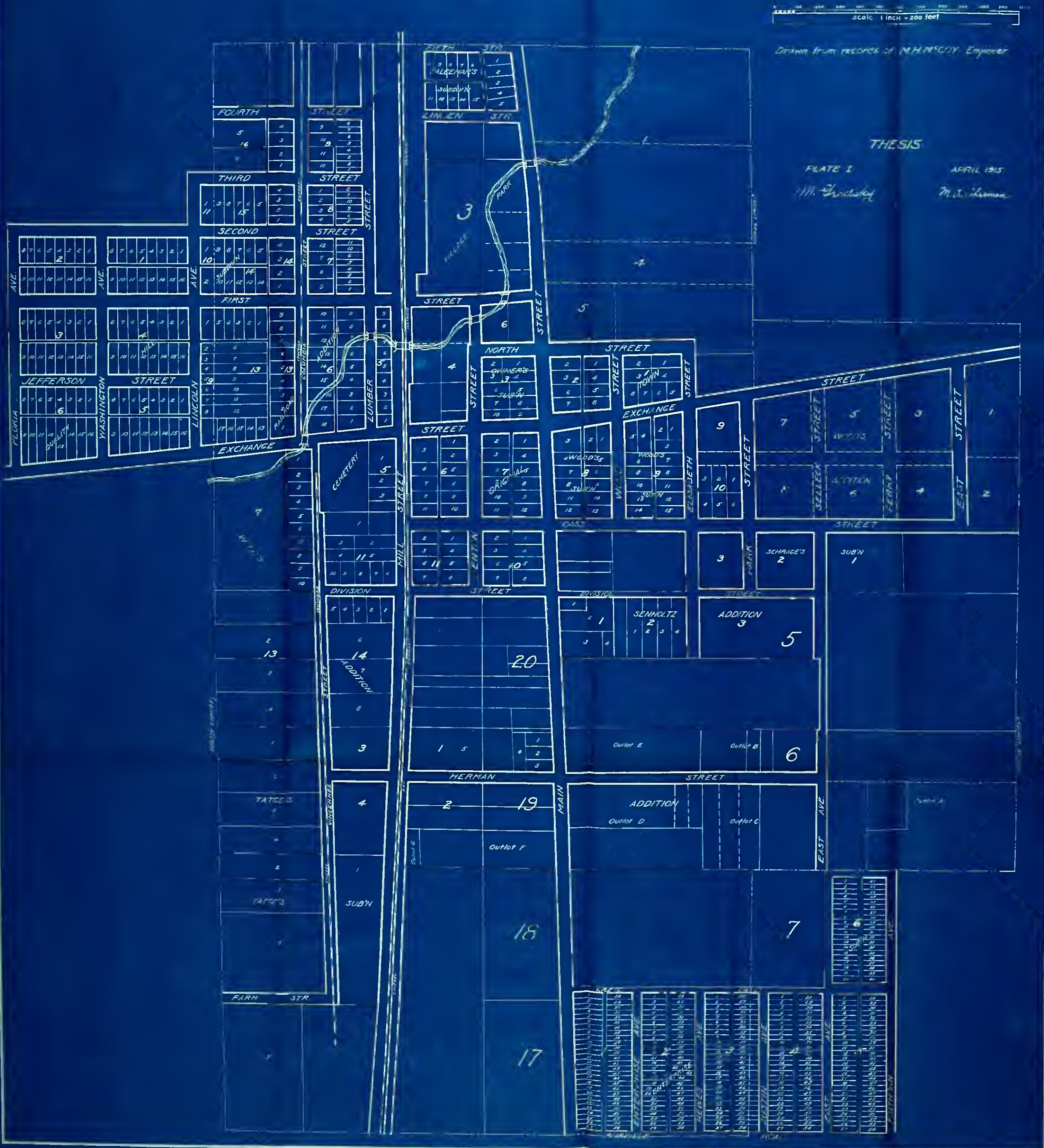
COST OF SEPTIC TANK.

Excavation	971 cu. yds.	@ 20¢	$ 194.20
Concrete	357.4 cu. yds.	@ 5.00	1787.00
Cement Finish -(1/2" thick)	60.67 cu. ft.	@ 4.40	266.80
Lumber (using forms three times)	5333.3 B.M.	@ 30¢	1600.00
Carpentry	16000 B.M.	@ 8¢	1280.00
Miller Automatic Siphon			60.00
10" Valves	5	@ 26.25	131.25
Manhole Covers	6	@ 8.00	48.00
Reinforcing Steel	704#	@ 2-1/2¢	17.60
	Total Cost		$5384.85

TOTAL COST OF SEWER SYSTEM.

Cost of Sewer	$31,248.90
Cost of Septic Tank	5,384.85
	$36,653.75

MAP
OF
CRETE ILL.



scale 1 inch = 200 feet

Drawn from records of M.H. McCOY Engineer

THESIS

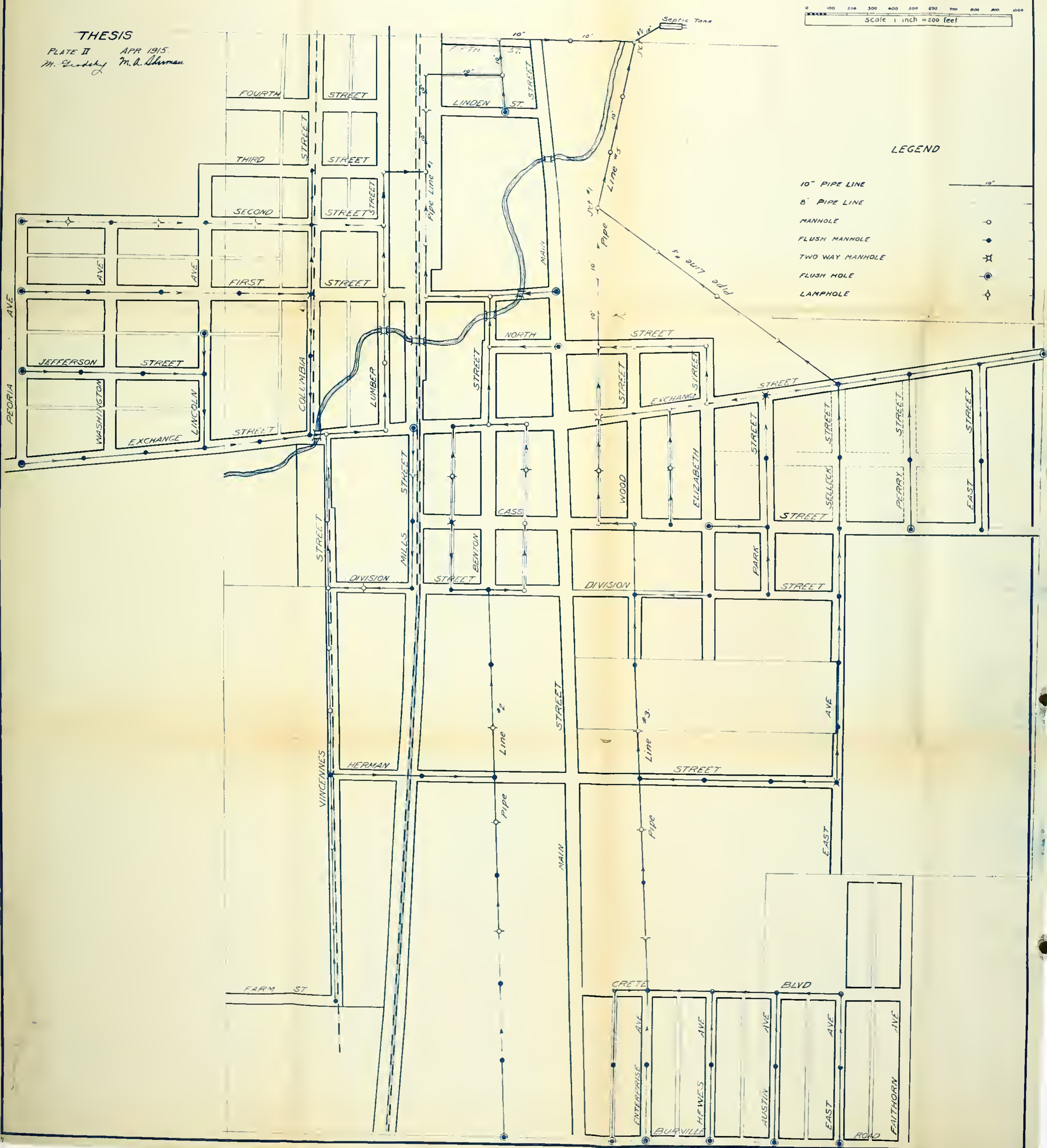
PLATE I

APRIL 1915

MAP
OF
CRETE ILL.

SHOWING

SEWERAGE SYSTEM



THESIS

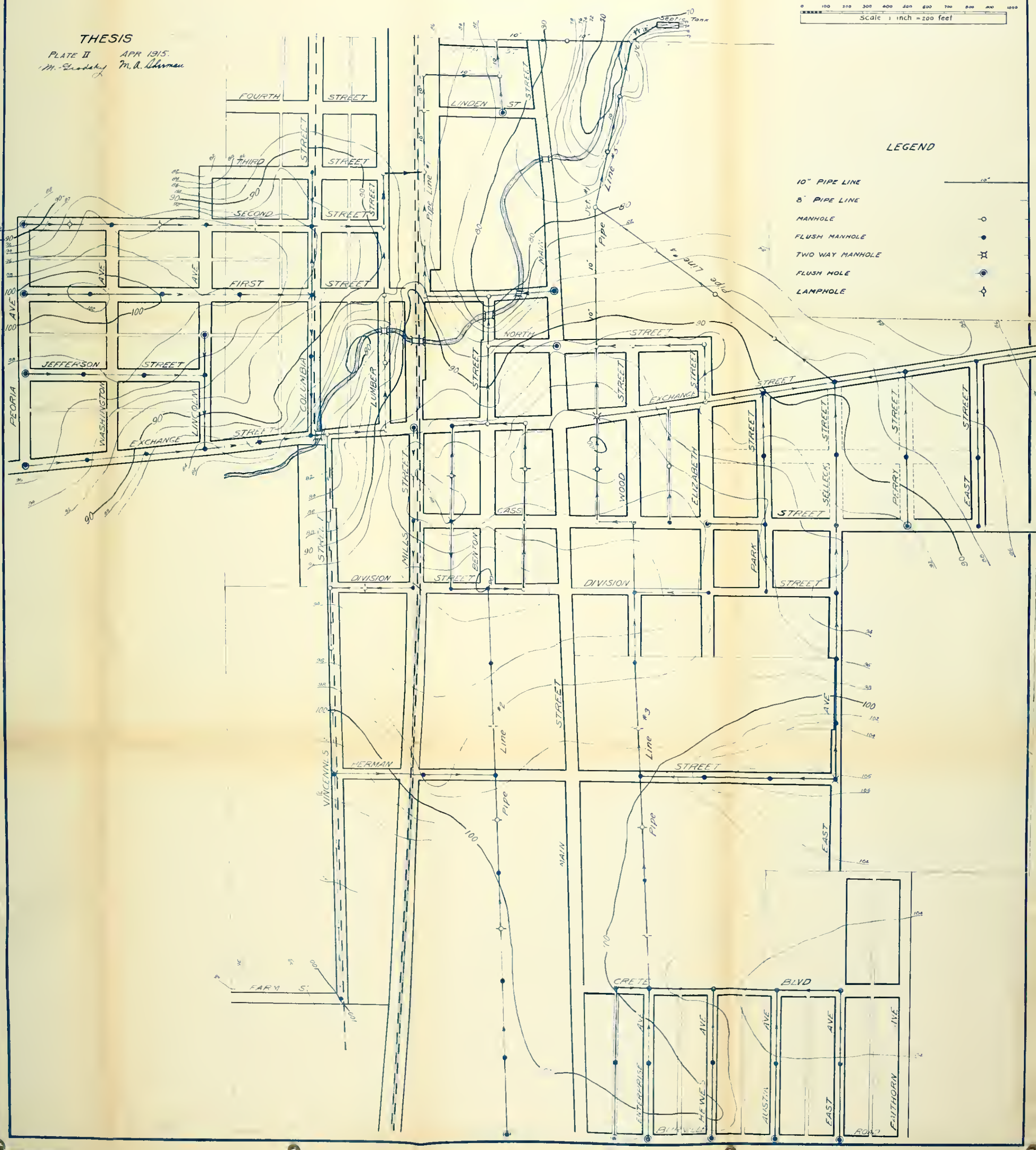
PLATE II APR 1915.

M. Grodsky M. A. Sherman

MAP
OF
CRETE ILL.

SHOWING

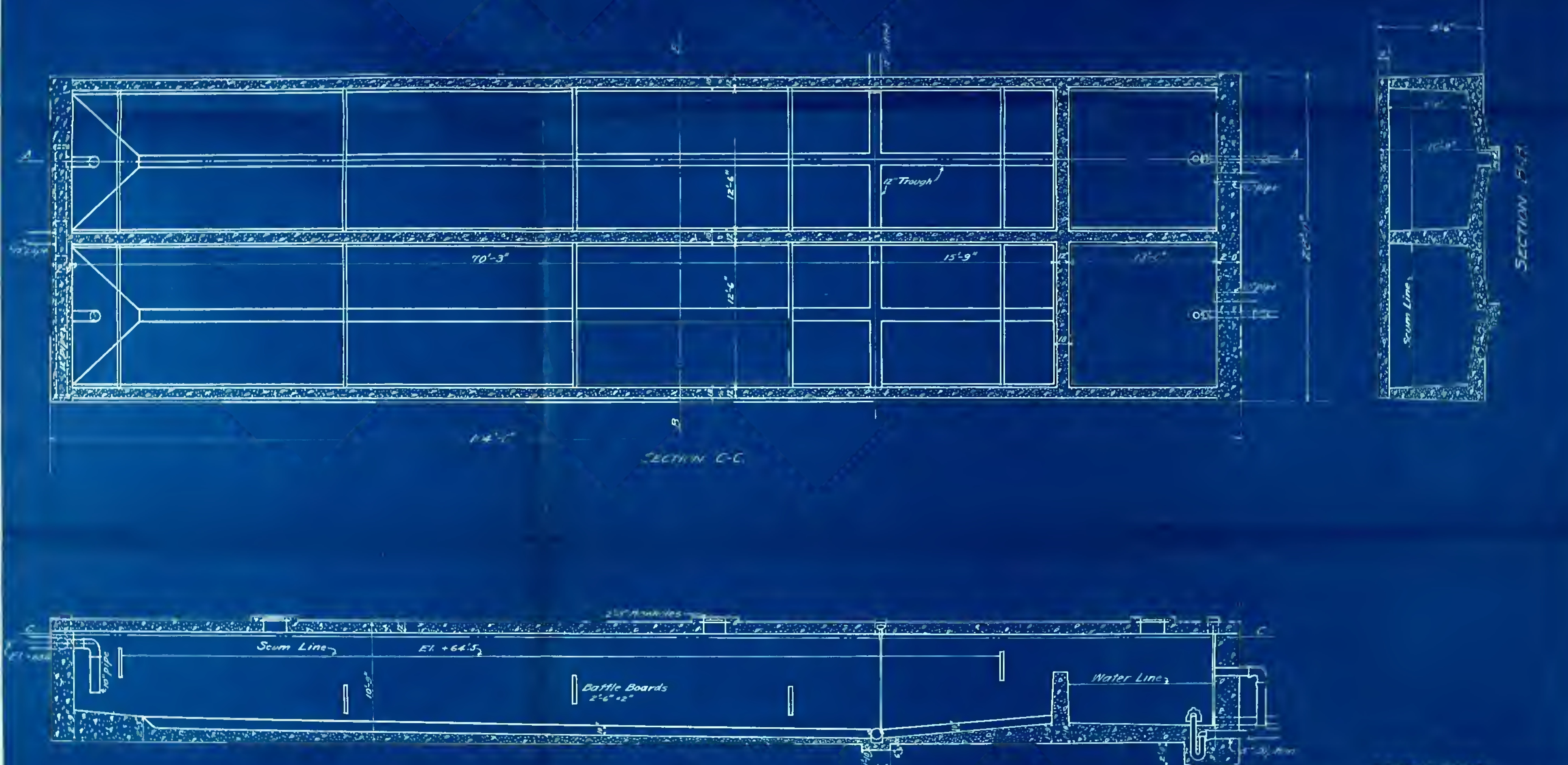
SEWERAGE SYSTEM



THESIS

PLATE II APR 1915.

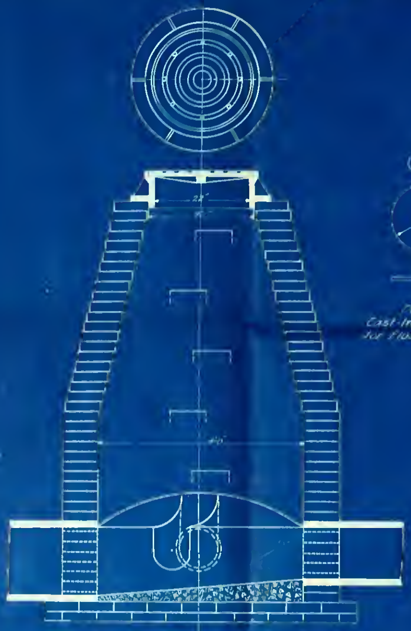
M. Grodsky M. A. Sherman



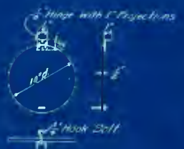
SEPTIC TANK
SANITARY SEWER SYSTEM
CRETE ILL.

THESIS

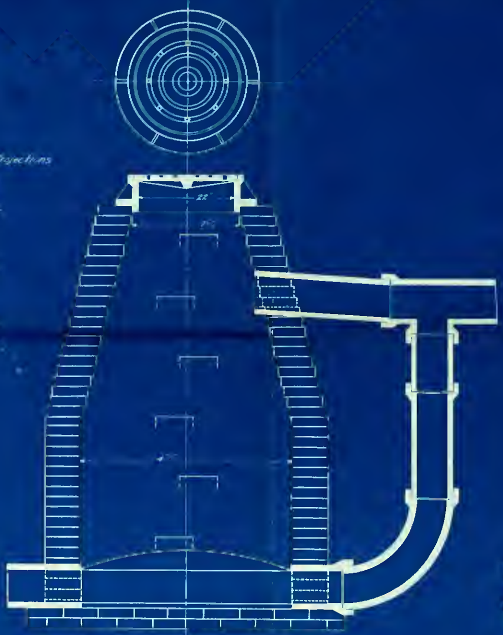
PLATE II APR 1915
M. [illegible], M. A. Sherman



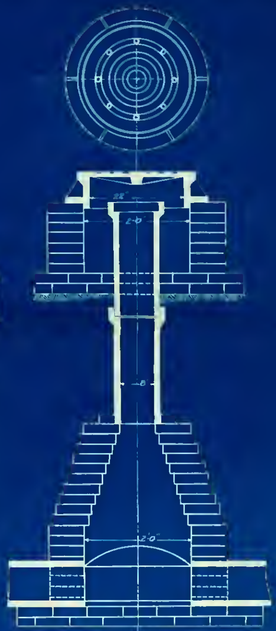
MANHOLE



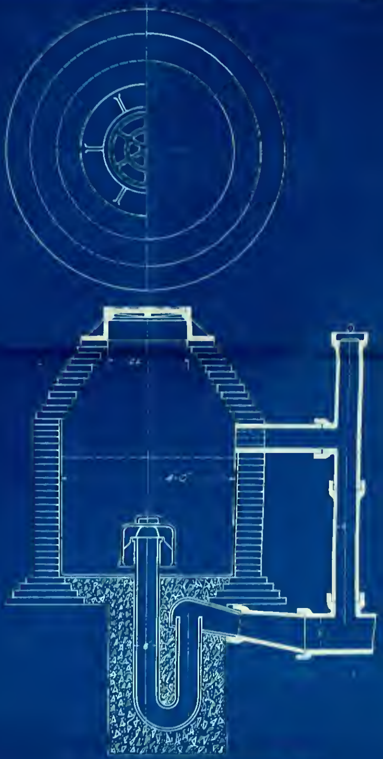
Detail of
Cast-Iron Valve Plate
for Flushing Manhole



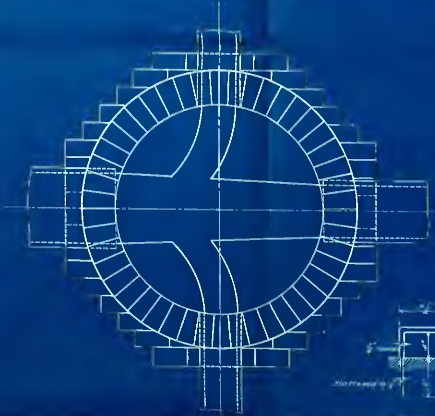
DROP MANHOLE

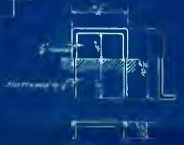


LAMPHOLE

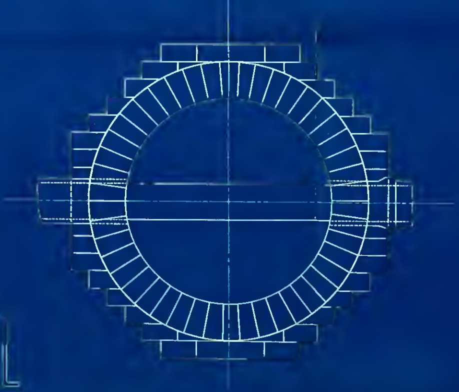


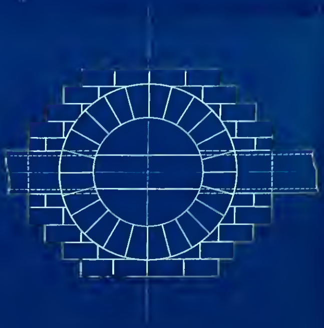
FLUSH-TANK

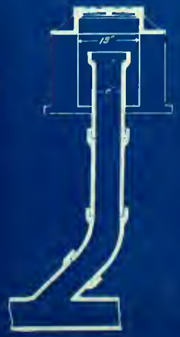




Detail of
Wrought Iron Step





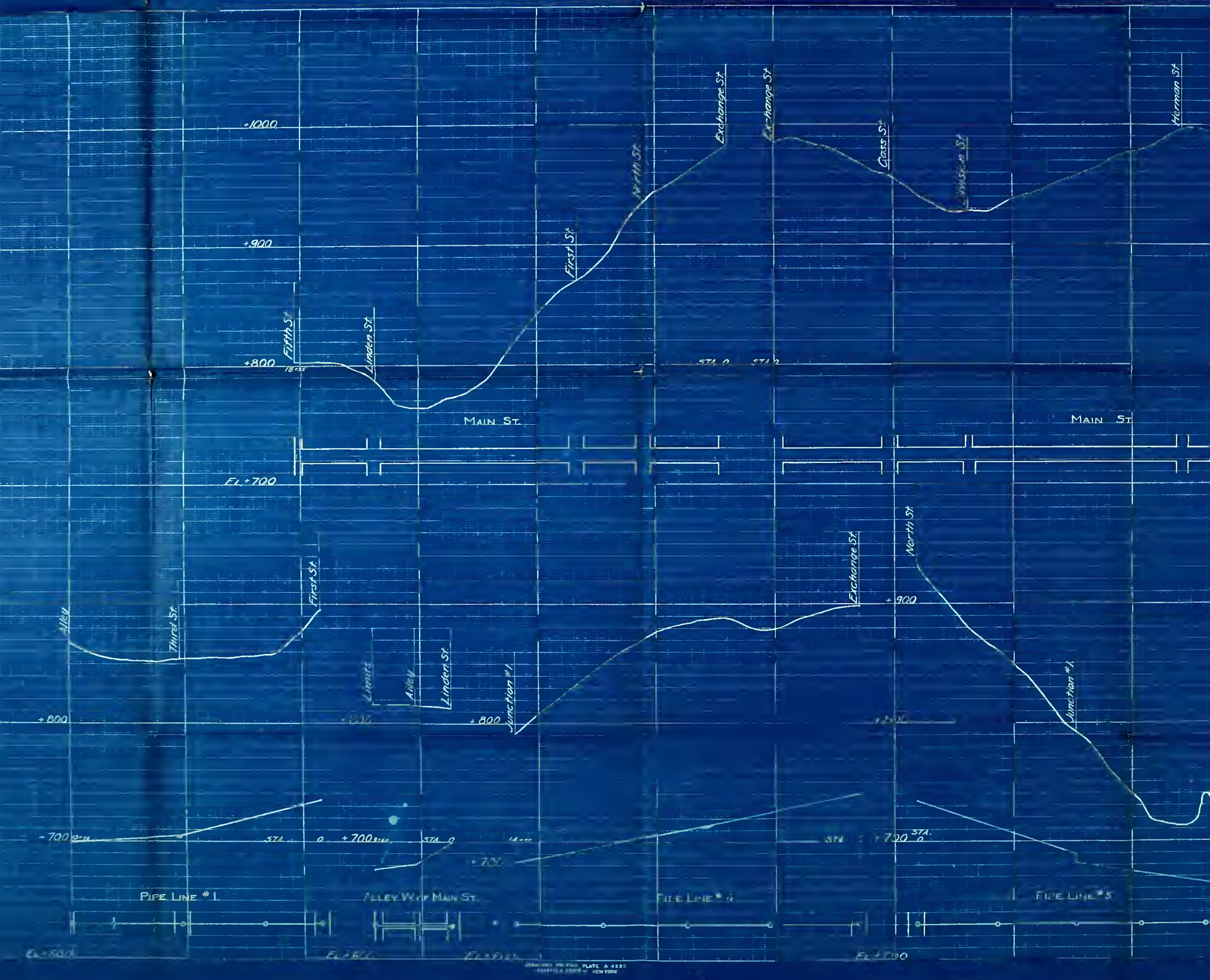


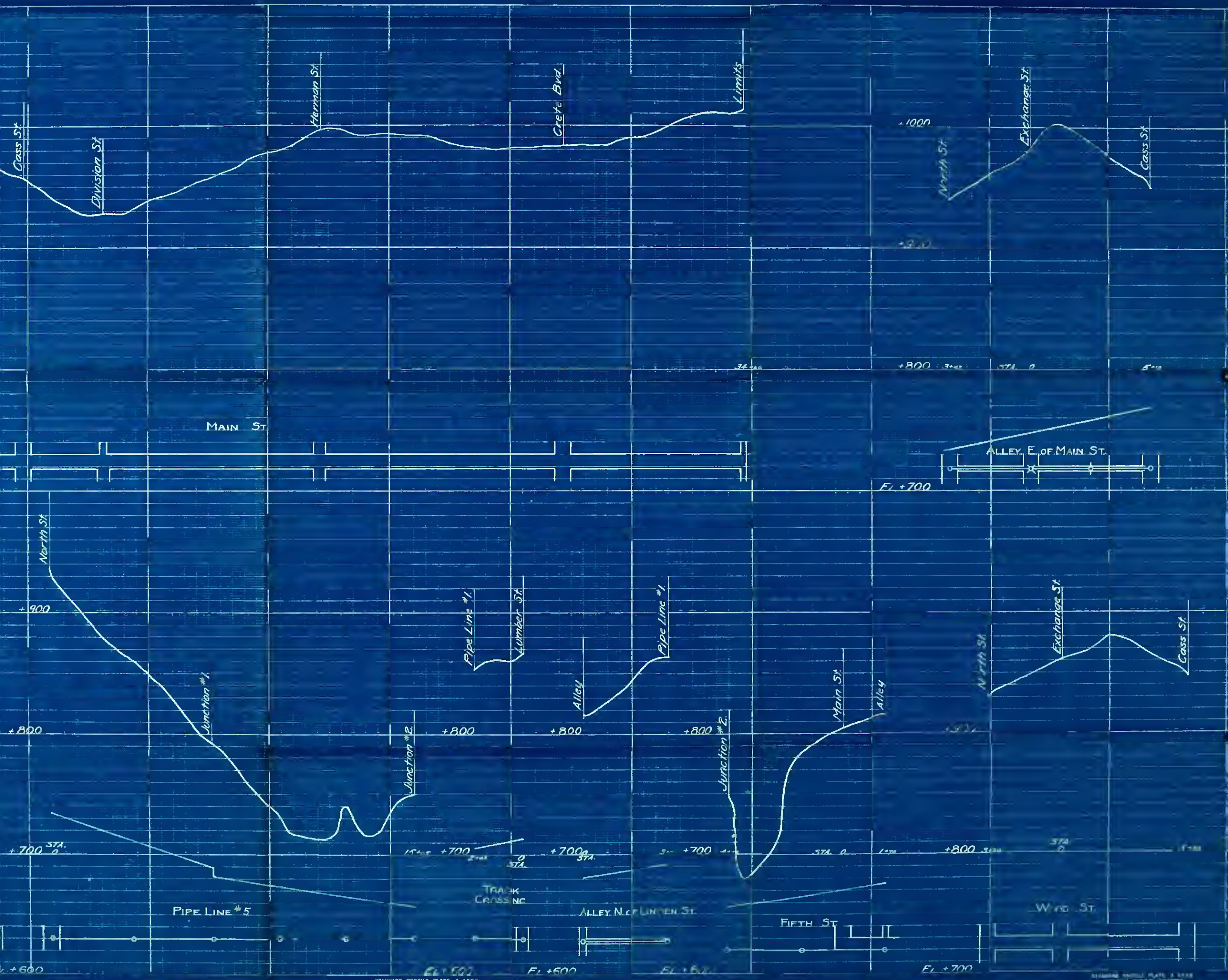
FLUSH HOLE

SEWER DETAILS
SANITARY SEWERAGE SYSTEM
CRETE, ILL.

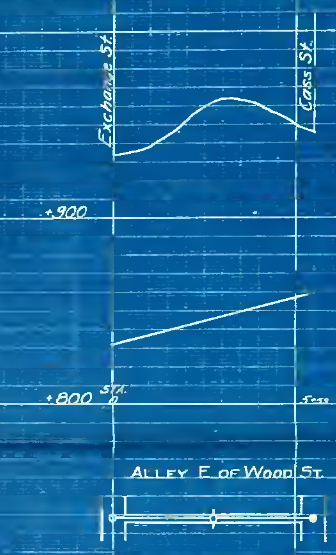
THESIS

PLATE IX APR. 1915.

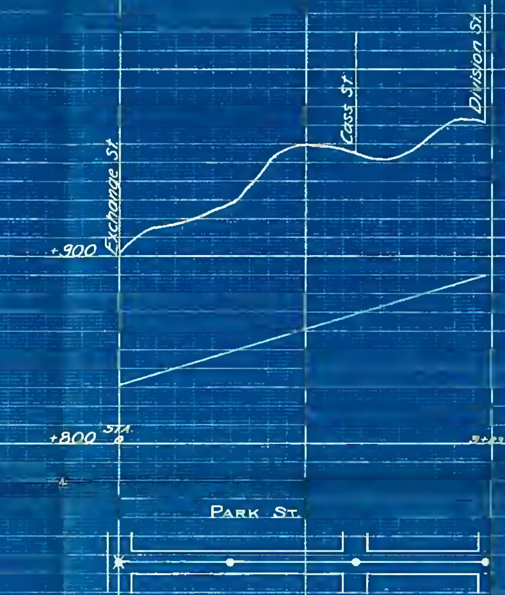

+1000
+900
+800
18+25
Fifth St.
Linden St.
Main St.
First St.
North St.
Exchange St.
Exchange St.
Cass St.
Division St.
Harmon St.
STA. 0
STA. 2
Main St.
El. +700
Alley
Third St.
First St.
Limits
Alley
Linden St.
Junction #1
Exchange St.
North St.
+900
Junction #1
+800
+800
+800
+800
+700
STA. 0
+700
STA. 0
+700
+700
STA. 0
Pipe Line #1
Alley W. of Main St.
Pipe Line #4
Pipe Line #5
El. +600
El. +600
El. +700
El. +700
STANDARD PROFILE PLATE A 4X20
NEW YORK
1


Cass St
Division St
Herman St
Crete Blvd
Limits
+1000
North St
Exchange St
Cass St
+900
34+66
+800
STA. 0
5+10
MAIN ST
ALLEY E. OF MAIN ST.
EL +700
North St
+900
Pipe Line #1
Lumber St
Alley
Pipe Line #1
Junction #1
+800
Junction #2
+800
+800
+800
Junction #2
Main St
Alley
North St
Exchange St
Cass St
+700
STA. 0
15+
+700
2+
0
STA.
+700
STA.
+700
STA. 0
+800
STA. 0
TRACK CROSSING
PIPE LINE #5
ALLEY N. OF LINDEN ST.
FIFTH ST
WOOD ST.
+600
EL +600
EL +600
EL +600
EL +700
STANDARD PROFILE PLATE A 4220
KEUFFEL & ESSER CO. NEW YORK
STANDARD PROFILE PLATE A 4220
KEUFFEL & ESSER CO. NEW YORK

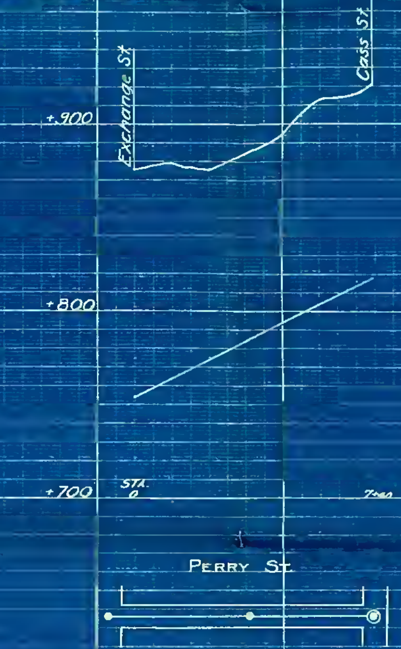
①



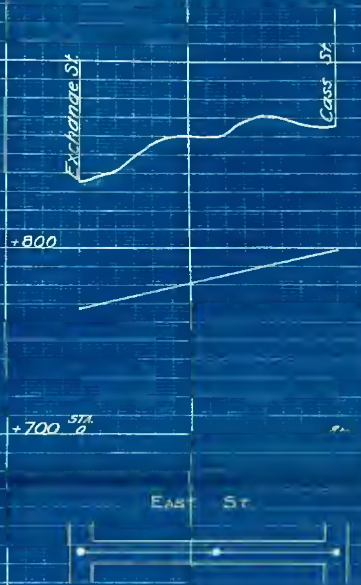
ALLEY E. OF WOOD ST.



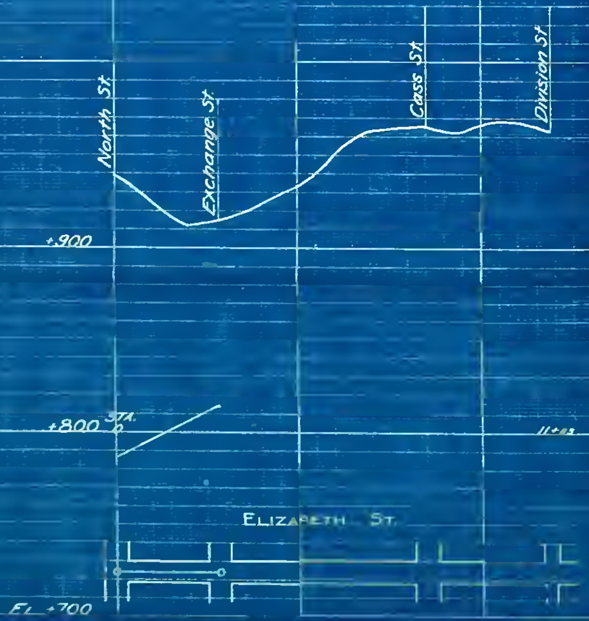
PARK ST.



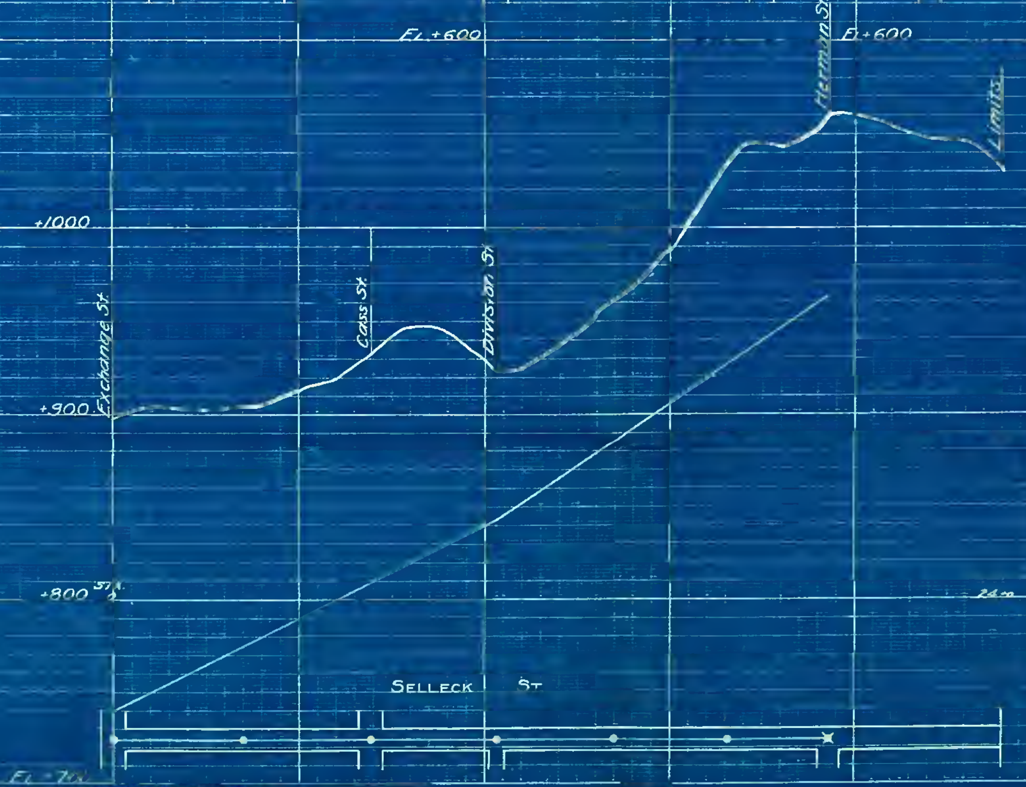
PERRY ST.



EAST ST.



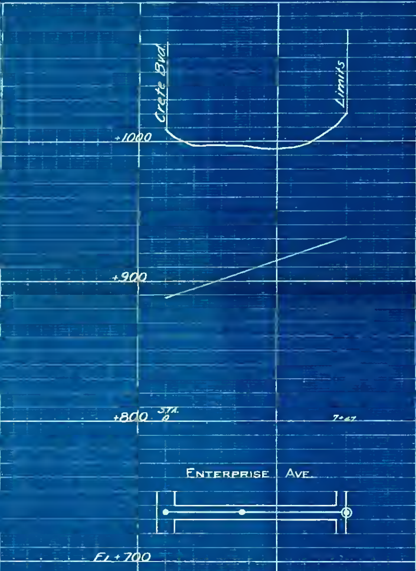
ELIZABETH ST.



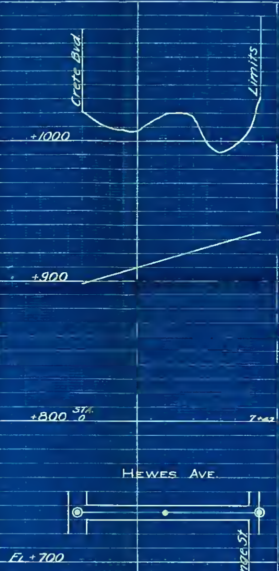
SELLECK ST.

STANDARD PROFILE PLATE A 4430
KEUFFEL & ESSER CO. NEW YORK

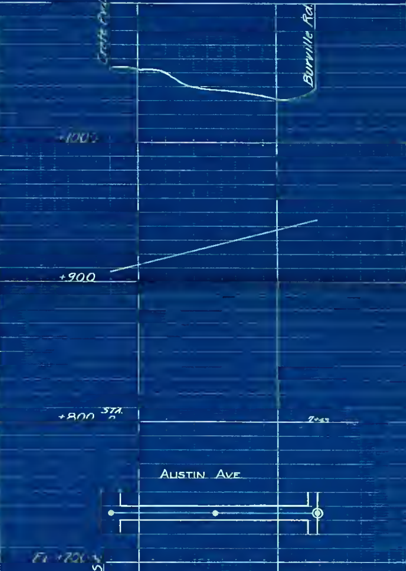
STANDARD PROFILE PLATE A 4430
KEUFFEL & ESSER CO. NEW YORK



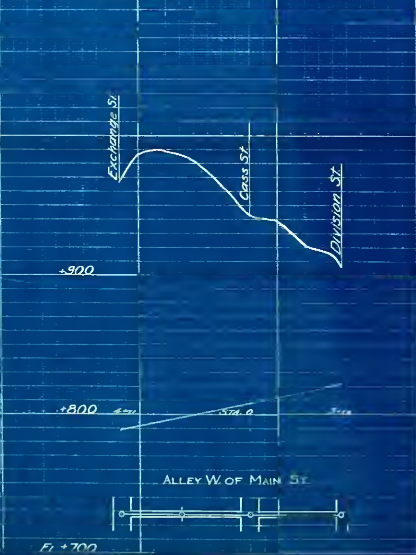
ENTERPRISE AVE.



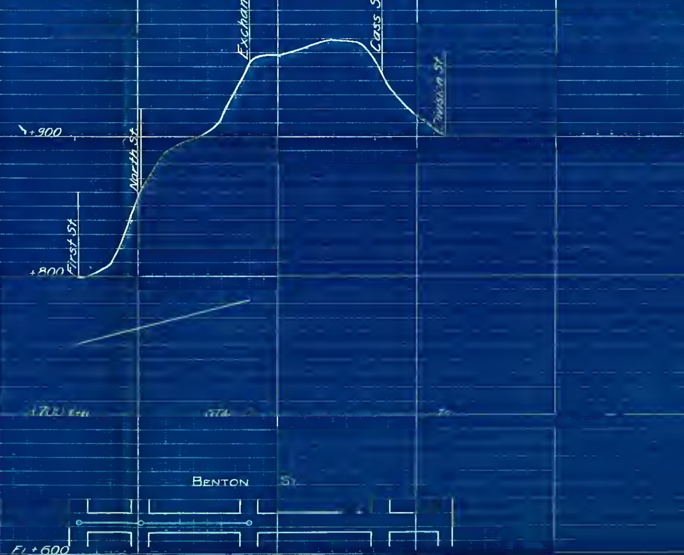
HEWES AVE.



AUSTIN AVE.

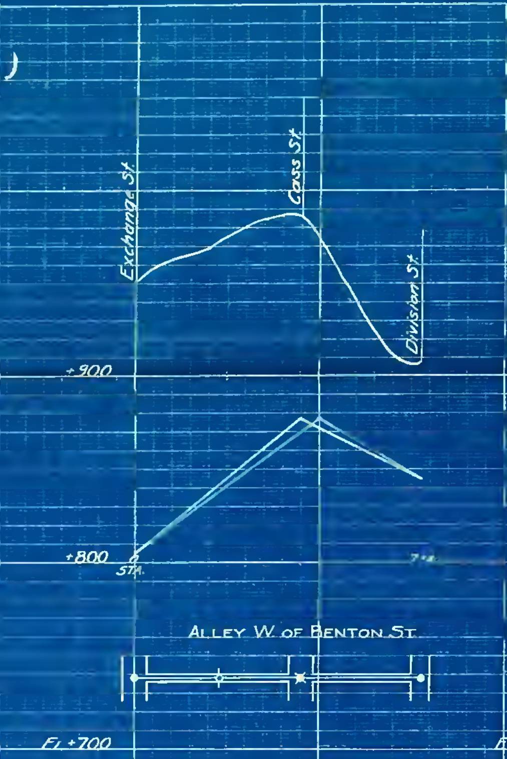


ALLEY W. OF MAIN ST.

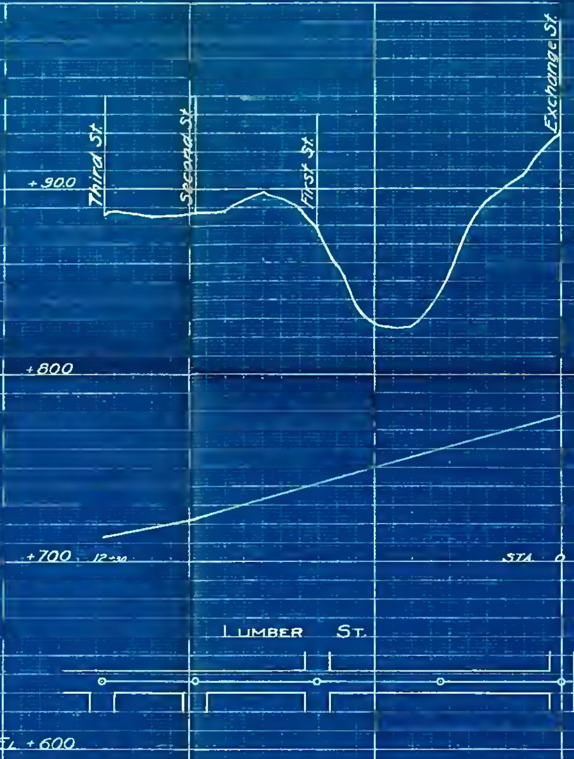


BENTON ST.

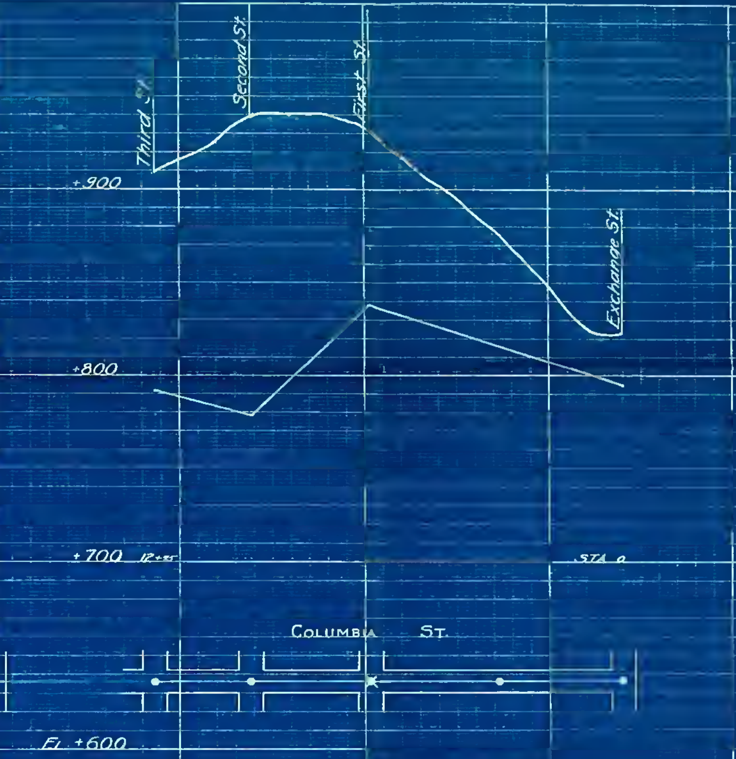
STANDARD PROFILE PLATE A
KEUFFEL & ESSER Co NEW



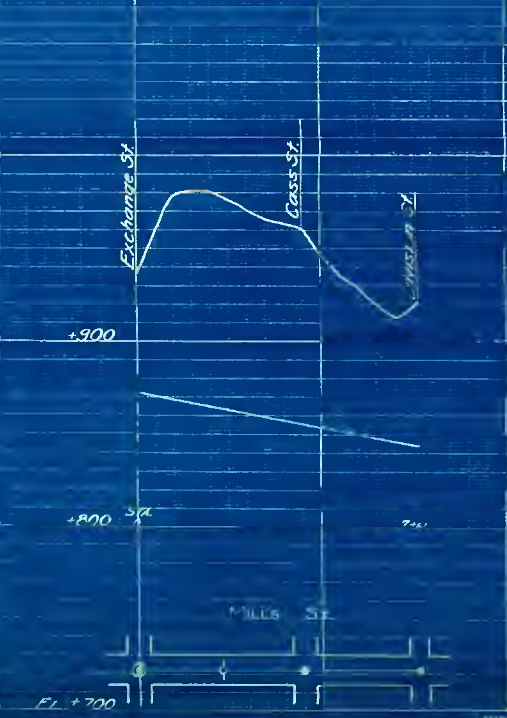
ALLEY W. OF BENTON ST.



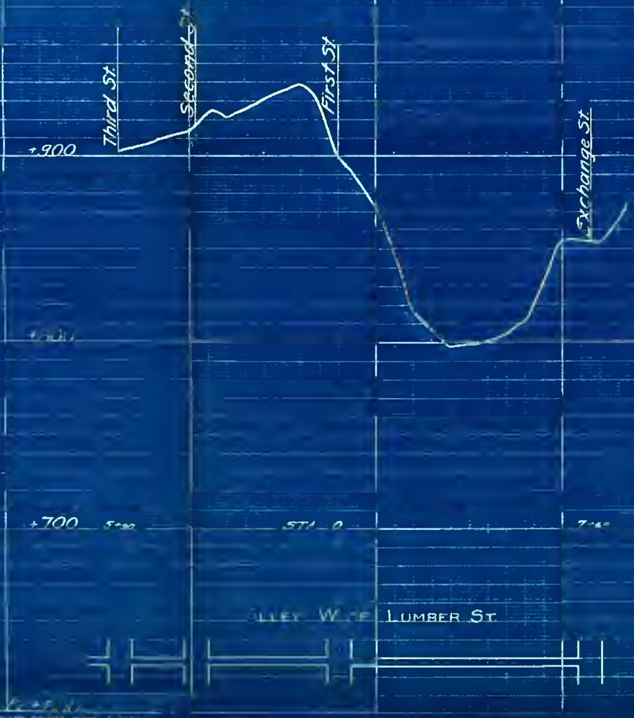
LUMBER ST.



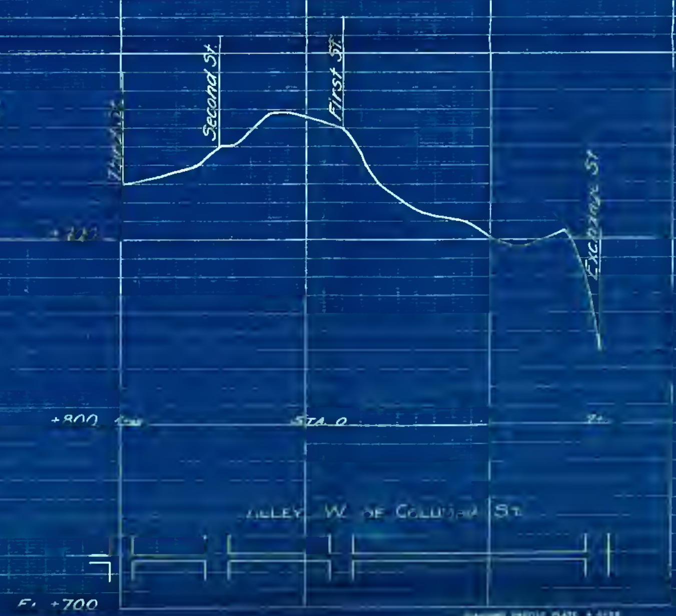
COLUMBIA ST.



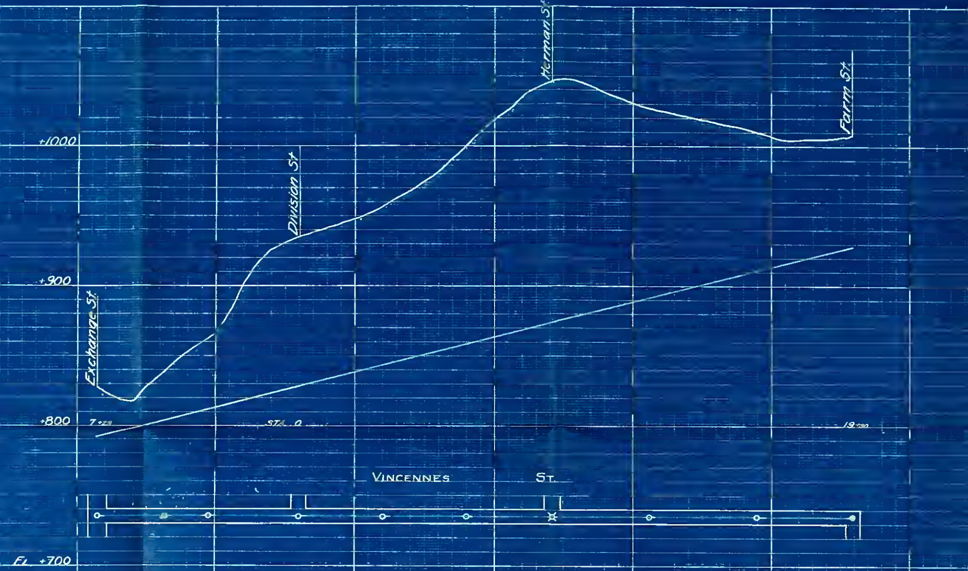
MILLS ST.

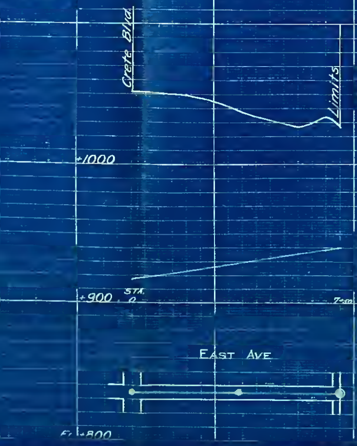


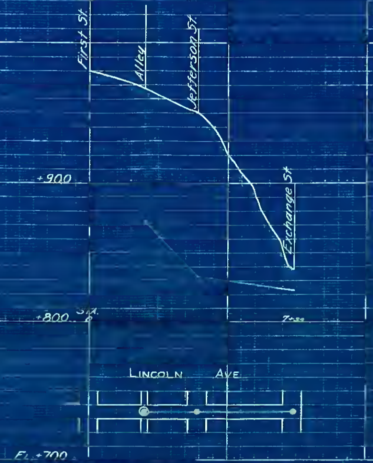
ALLEY W. OF LUMBER ST.



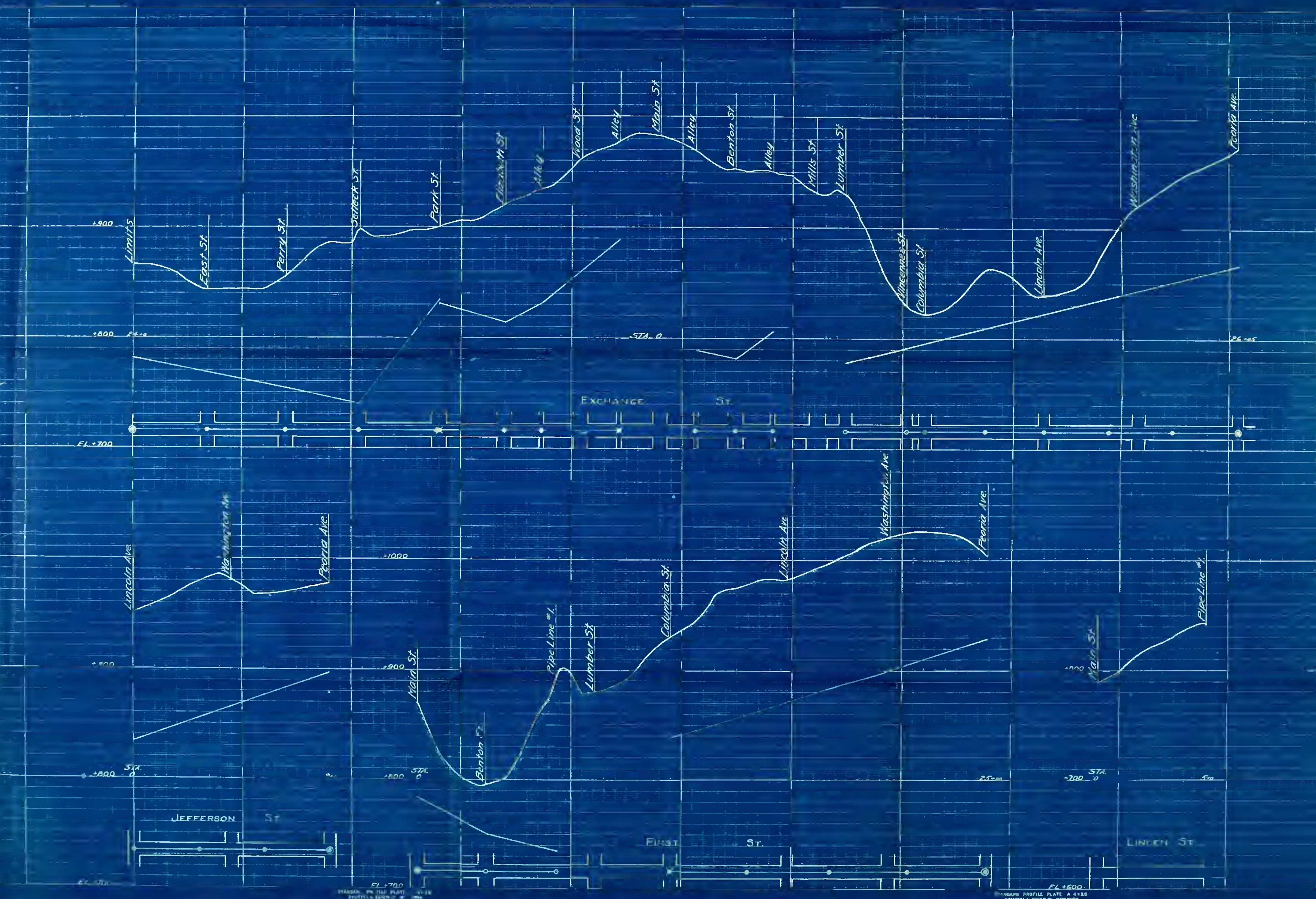
ALLEY W. OF COLUMBIA ST.

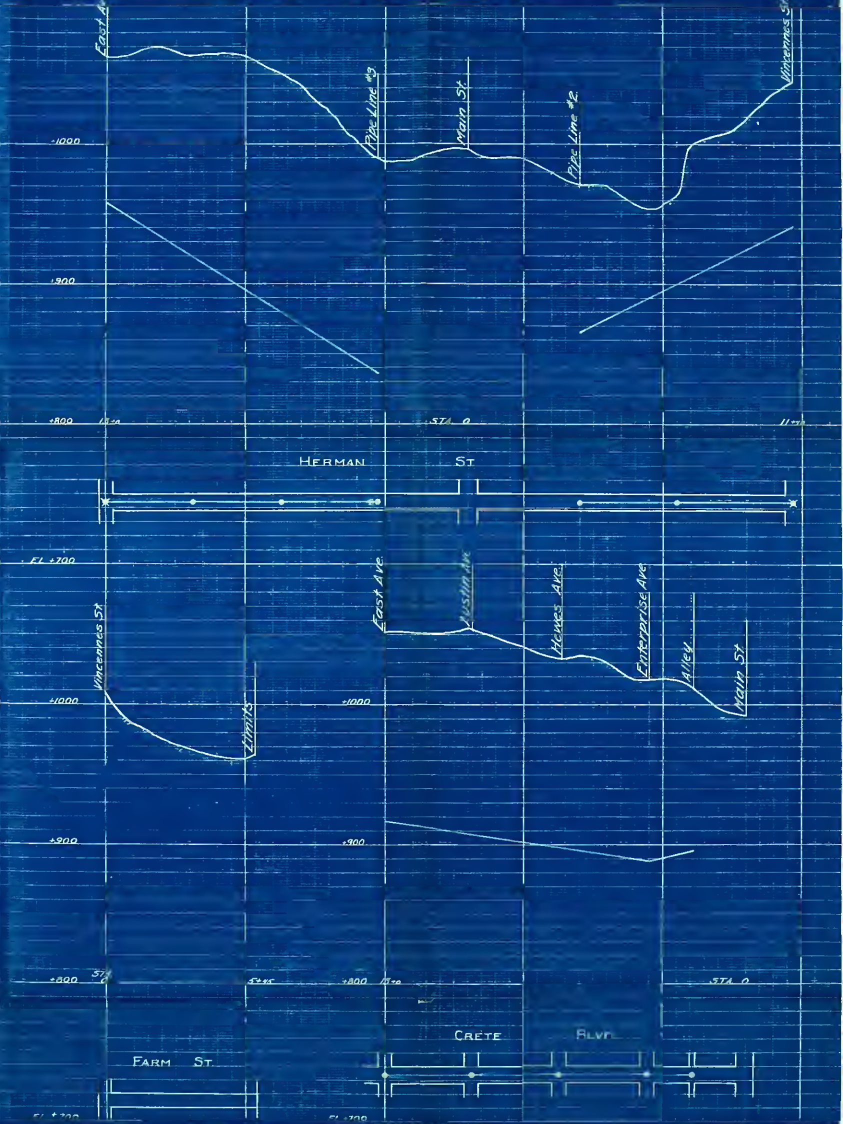

VINCENNES ST.

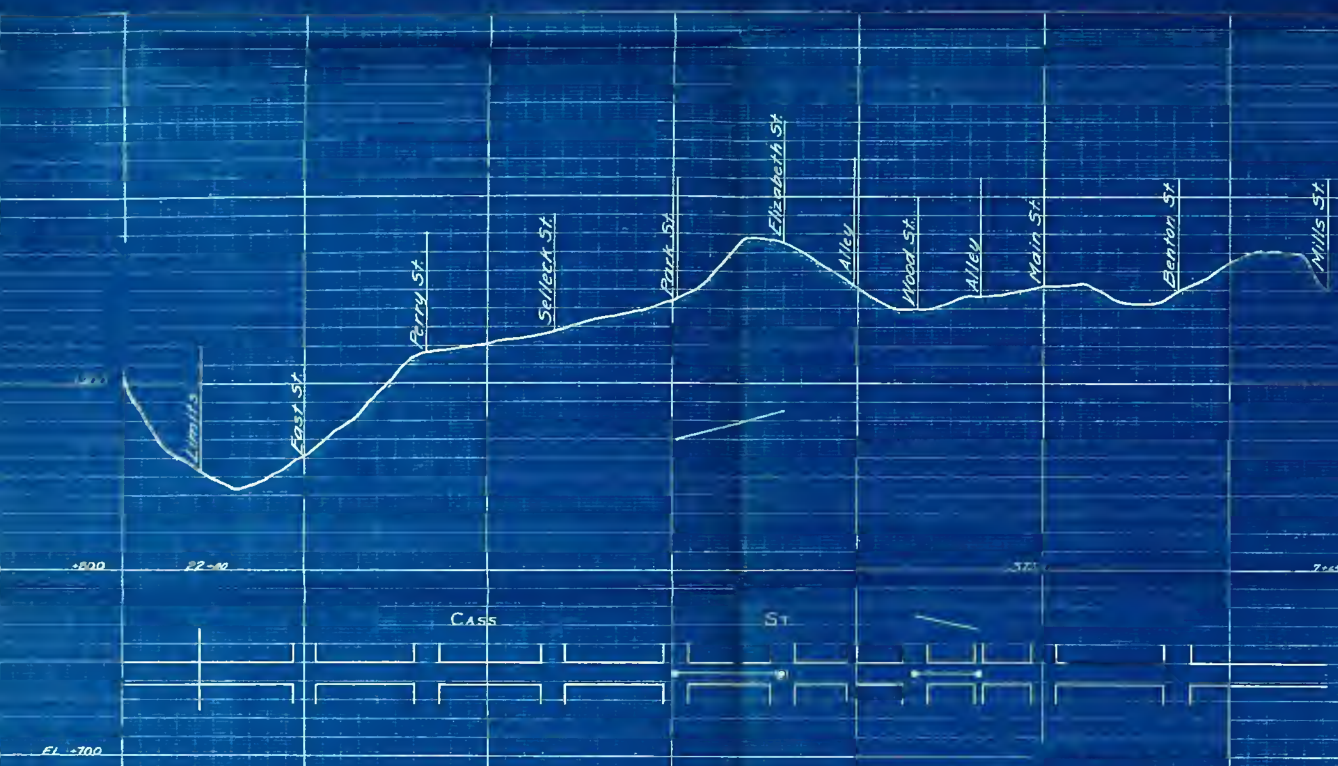

EAST AVE

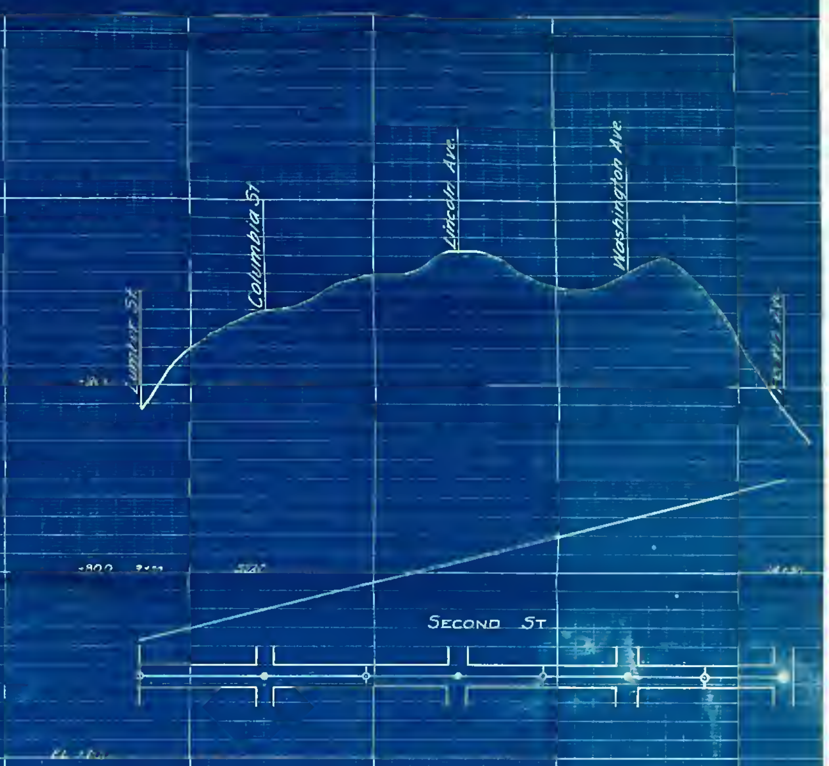

LINCOLN AVE

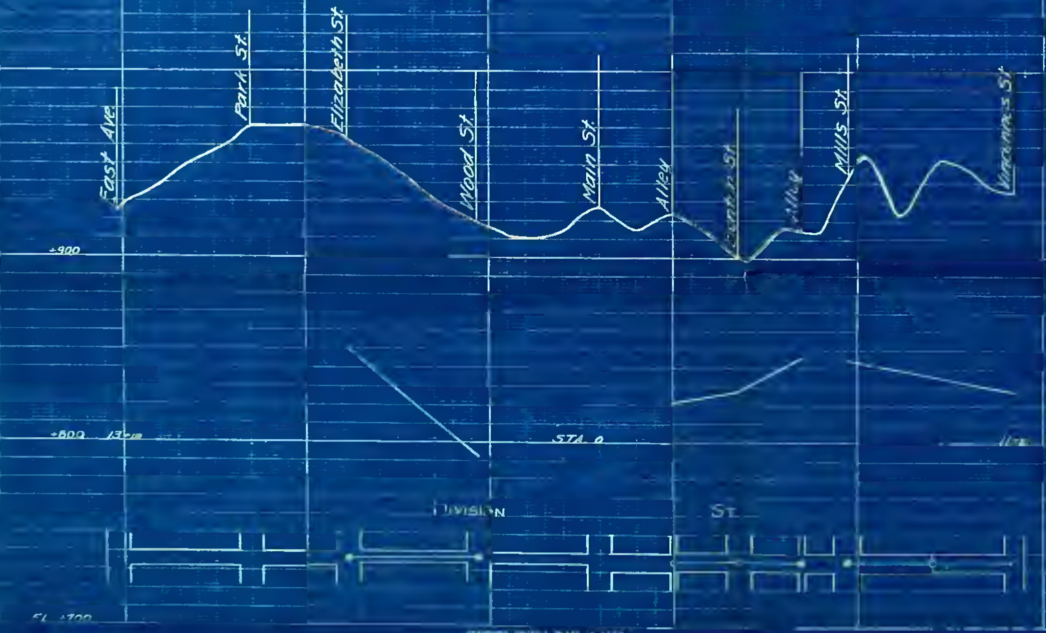
STANDARD PROFILE PLATE A 4X20
KEUFFEL & ESSER Co. NEW YORK

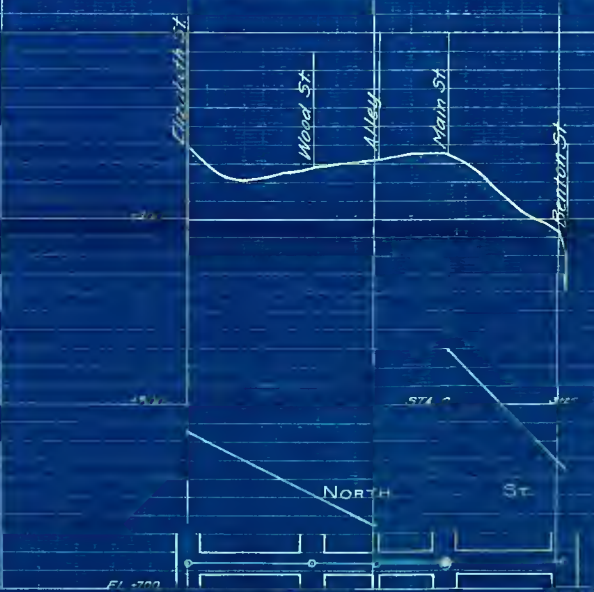

+900
Limits
East St
Perry St
Jetteck St
Park St
Elizabeth St
Alley
Wood St
Alley
Main St
Alley
Benton St
Alley
Mills St
Lumber St
Vincennes St
Columbia St
Lincoln Ave
Washington Ave
Peoria Ave
+800
24+00
STA. 0
26+05
EXCHANGE ST.
EL +700
Lincoln Ave
Washington Ave
Peoria Ave
+900
+800
STA. 0
JEFFERSON ST.
+1000
+900
Main St
Benton St
Pipe Line #1
Lumber St
Columbia St
Lincoln Ave
Washington Ave
Peoria Ave
+800
STA. 0
25+00
FIRST ST.
EL +700
Main St
Pipe Line #1
+800
+700
STA. 0
5+0
LINDEN ST.
EL +600
STANDARD PROFILE PLATE A 4x20
KEUFFEL & ESSER CO. NEW YORK

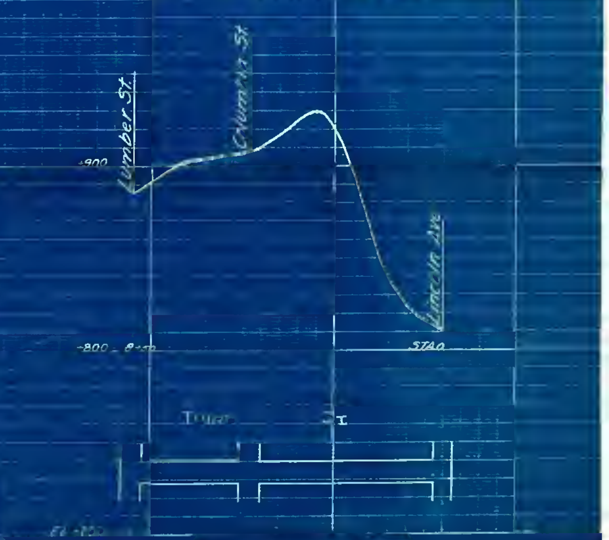

East Ave
Pipe Line #3
Main St
Pipe Line #2
Vincennes St
+1000
+900
+800
13+0
STA. 0
11+40
HERMAN ST
EL +700
Vincennes St
Limits
+1000
+900
+800
STA. 0
5+45
FARM ST.
EL +700
East Ave
Austin Ave
Hewes Ave
Enterprise Ave
Alley
Main St
+1000
+900
+800
13+0
STA. 0
CRETE BLVD.
EL +700

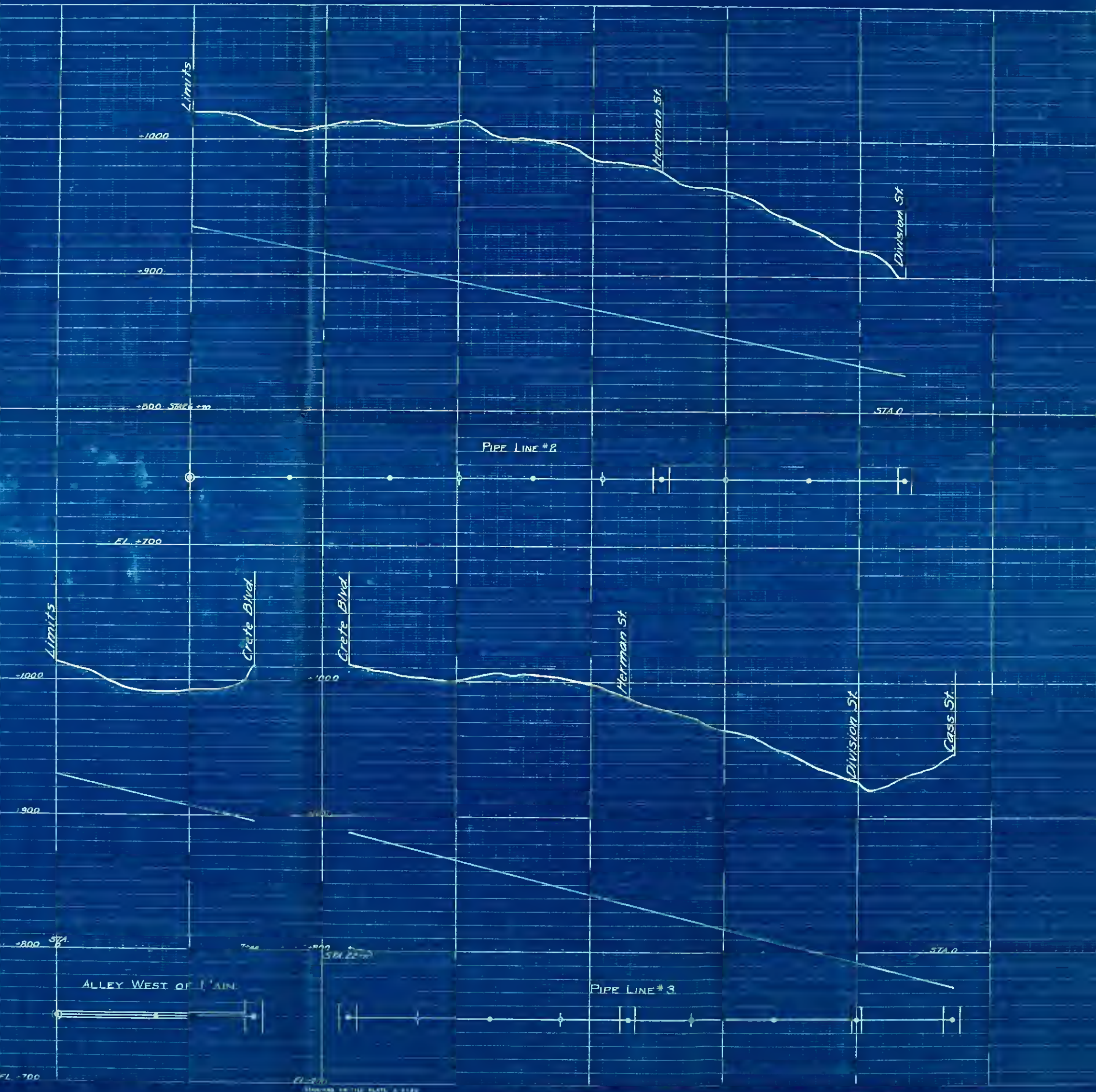

Limits
East St
Perry St
Selleck St
Park St
Elizabeth St
Alley
Wood St
Alley
Main St
Benton St
Mills St
+900
+800
22+00
EL +700
Cass
St


Lumber St
Columbia St
Lincoln Ave
Washington Ave
+900
+800
Second
St


East Ave
Park St
Elizabeth St
Wood St
Main St
Alley
Benton St
Alley
Mills St
+900
+800
13+00
STA 0
EL +700
Division
St
STANDARD PROFILE PLATE A 4X20
KEUFFEL & ESSER CO NEW YORK


Elizabeth St
Wood St
Alley
Main St
Benton St
STA 0
EL +700
North
St


Lumber St
Columbia St
Lincoln Ave
+900
+800
STA 0
Third
St
STANDARD PROFILE PLATE A 4X20
KEUFFEL & ESSER CO NEW YORK


Limits
Herman St.
Division St.
+1000
+900
+800
STA 26+10
STA 0
Pipe Line #2
EL +700
Limits
Crete Blvd.
Crete Blvd.
Herman St.
Division St.
Cass St.
+1000
+1000
+900
+800
STA. 0
+800
STA. 22+10
STA 0
Alley West of Main
Pipe Line #3
EL +700
EL +700